THE IMPACT OF PROGRAM EXPERIENCES ON THE RETENTION OF WOMEN ENGINEERING STUDENTS IN MEXICO

A Dissertation

by

MARIA DEL CARMEN GARCIA VILLA

Submitted to the Office of Graduate Studies of
Texas A&M University
in partial fulfillment of the requirements for the degree of

DOCTOR OF PHILOSOPHY

December 2008

Major Subject: Educational Administration and Human Resource Development

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Approved by:

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ABSTRACT

The Impact of Program Experiences on the Retention of Women

Engineering Students in Mexico. (December 2008)

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This qualitative study sought to describe and understand the experiences of female students attending engineering colleges in Mexico and the sources of support and strategies that helped them persist in their programs. The participants were 20 women engineering students enrolled in at least their third year in selected colleges of engineering in Mexico, in both public and private universities, and pursuing a variety of engineering majors.

Findings focus on the experiences of female students that helped them stay in their programs. Participants described their experiences in college as very challenging and perceived the environment as hostile and uncertain. In addition, patriarchal Mexican cultural values and stereotypes were identified by students as influencing and helping shape the engineering environment. However, in this context, participants were able to find sources of support and use strategies that helped them remain in their majors, such as a strong desire to succeed, a perceived academic self-ability; and support from their families, peers, institutions, and—most importantly—their professors. Furthermore, the

fact that participants were able to persist in their programs gave them a sense of pride and satisfaction that was shared by their families, peers, and faculty.

In addition, participants experienced contradictory forces and were constantly negotiating between rejecting traditional gender norms and upholding the norms that are so deeply engrained in Mexican society. Finally, as the students advanced in their programs and became "accepted to the club," they tended to reproduce the male-dominated value system present in engineering colleges accepting their professors' expectations of being "top students," accepting the elitist culture of engineering superiority, and embracing the protection given by their male peers.

Retention of Mexican female engineering students is important for all engineering colleges, but cultural factors must be taken into consideration. The dominance of machismo attitudes and values in Mexican culture present specific challenges to achieve an environment more supportive of women in Mexican engineering colleges. Institutions need to be proactive and creative in order to help faculty and administrators provide an environment in which female engineering students can be successful.

DEDICATION

To my husband, Juan Carlos Villa who has been proud and supportive of my work and with whom I have shared 22 years of happy life.

Thank you for being a pillar of my strength. *Te quiero mucho.*

To my daughters Carmina y María José Villa, *mi más grande bendición.*

A mi padre Juan García por su ejemplo de rectitud y trabajo. A mi madre Tacha Higuera quien a través de sus hijos hizo realidad su sueño de ir a la universidad.

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I wish to thank the young women students in engineering who took the time to share their stories with me. They not only help me in this project, but they also opened their hearts with the desire that their experiences would encourage other young women to enroll in engineering and achieve their educational goals.

I want to acknowledge and express my gratitude to the co-chairs of my committee, Dr. Jennifer A. Sandlin, and Dr. M. Carolyn Clark.

Thanks to Dr. Sandlin for her support and encouragement and for being a constant source of guidance. Our conversations were very important in my learning process and helped me throughout the duration of the study. For your commitment to my work, your patience, and for reading the bilingual text, thanks Jenny!

Thanks to Dr. Clark for providing me with mentorship and moral support throughout the years that I have known her. The inspiration for doing this research came from the adult education program she heads at Texas A&M. The program was one of the most formative experiences in my life. Dr. Clark always showed an interest in my study and encouraged me to follow it as a dissertation. Thanks for giving me your time and expertise to better my work.

I would like to thank my advisory committee members, Dr. Christine Stanley, for her unconditional support and guidance, for showing her professionalism and excellence in the job, and for sharing her happy Caribbean soul; and Dr. Lauren Cifuentes for her dedication and insights and for sharing the love for the Hispanic culture.

A very special thanks to Dr. Elsa González y González who supported me throughout the analysis of data and writing of the dissertation. She offered me her insights and provided me with moral support and empathy, as well as friendship. *Muchas gracias por tu apoyo y ayuda.*

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This accomplishment would not have been possible without the support of my family, my husband, Juan Carlos Villa, and my daughters, Carmina Villa and María José Villa. Thanks for being there.

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CHAPTER I

INTRODUCTION

Background to the Problem

The number of students attending higher education has increased substantially in the last three decades both in Mexico and in the United States (*Asociación Nacional de Universidades e Instituciones de Educación Superior* [ANUIES], 2003; Fitzgerald & Delaney, 2002). In 1970 in the U.S., 32% of the population between 20 and 24 years of age was enrolled in postsecondary education, compared to nearly 50% in 2000. Mexico has experienced similar growth, according to the National Association of Universities and Higher Education Institutions (ANUIES, *Asociación Nacional de Universidades e Instituciones de Educación Superior*). For example, in 1970 only 0.05% of the total population between the ages of 20 and 24 years were enrolled in some type of postsecondary education, compared to 17.24% in 2000 (ANUIES, 2003; National Center for Education Statistics [NCES], 2003).

In spite of this growth, today many youth and young adults still face considerable challenges in achieving access to higher education. In the United States increases in the costs of college are causing individuals to face enormous barriers to attending college. This situation becomes even more critical if we consider that demographic growth in the

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The style and format for this dissertation follow that of the *Journal of Educational Research.*

U.S. is dramatically impacting the number of students enrolled in higher education, and in the near future this growth will include 80% of non-white students and a disproportionate number of low- and moderate- income students (Fitzgerald & Delaney, 2002). In Mexico, although higher education was founded with "social welfare means and for the benefit of the society" (Silva Herzog as cited in González y González, 2004, p. 15), today, only 22% of Mexicans between 20 and 24 years of age have access to higher education (National Center for Education Statistics [SEP], 2007). Higher education in Mexico is still a privilege for few people. Mexican enrollment in higher education is projected to continue growing over the next decades; however, state and federal funds to maintain these students are limited.

Mexican higher education today has two distinctive characteristics. First, student enrollment in higher education is increasing, due in part to demographic growth and in part to successful government policies focused on increasing the rates of high school graduation. Second, higher education in Mexico suffers from constrained resources due to government spending priorities focused on other realms such as public health; furthermore, the costs of higher education continue to increase (Martínez Rizo, 2000). Consequently, if Mexico wishes to meet its growing demands for higher education, it needs a diversified higher education system that maintains the quality of education and responds to the needs of the society. This higher education system would need to link education to productive sectors and to engage students in social activities that develop values of justice and social equity.

While many students are still shut out of higher education, the increasing educational opportunities for all students reported at the beginning of this chapter have positively impacted gender equality in higher education. Women now have a significant presence in higher education, whereas in the past men were disproportionately represented. In the 1970s, for instance, men constituted nearly 80% of the student population in Mexico and 60% in the U.S. However, in terms of sheer numbers of women enrolled in higher education, women have reached parity with men, and now even constitute the majority of enrolled students (ANUIES, 2003; Bae, Choy, Giddes, Sable & Synder, 2000).

However, while females and males are now enrolled in equal numbers in higher education, throughout history higher education has played a role in preventing women from attaining equal status in society. Women have experienced institutional discrimination in higher education since gaining access to universities. For instance, historical exclusion of women from higher education in Mexico has been documented (Galván, 1989; García Guevara, 2002b; Montero Moguel & Esquivel Alcocer, 2002), while government intervention was used to encourage female participation in certain professions, such as teaching, nursing, and clerical work. These interventions were possible in a context where women had few legal rights and were strongly discouraged from professions like politics or law. Female students and faculty members have also faced limited academic opportunities; have been barred from entering colleges and universities; have suffered prejudices such as lack of intellectual acceptance; and have

experienced lack of financial support (Bustos, 2003; García Guevara, 2002b; Nidiffer & Bashaw, 2001).

In recent years, educational opportunities have improved for women in Mexico and the U.S. Today male and female participation in undergraduate higher education is balanced. But although the enrollment of women in higher education has increased, the separation between traditionally "masculine" or "feminine" [1] academic programs has not disappeared. While more women are entering all areas of higher education, there are proportionately more women entering traditionally "feminine" programs like Liberal Arts, Social Science, and Health programs (nursing). Bustos (2003) remarked that in Mexican society, traditionally "feminine" programs have lower prestige, and, consequently, lower salaries.

Feminist theories have helped explain why higher education has kept women from attaining equal status in the society. Feminist pedagogy focuses on women's educational needs and assumes traditional educational systems are based on the needs of males from privileged race and class positions. In addition, poststructural feminism conceptualizes gender as a "system of social relations that are negotiated at daily interactions and at broader social structures" (Flannery & Hayes, 2000, p 15). Feminist pedagogies, widely conceived, are in general concerned with increasing women's choices and status in the society:

[1] Bustos (2003) described "feminine" programs as those programs where the majority of the students are female. In Mexican higher education those programs include education, liberal arts, and health (nursing) among others. These programs have less social prestige and lower salaries. Enrollment in these programs is due in part to the domestic and care functions associated in Mexican society as women's roles.

> The principle and practice of full and equal partnership of women and men is in itself a significant reform in gender roles and is yet to be achieved… Education, in general, and universities in particular have a special formative and exemplary role to play in fully engaging talented women in all aspects of academic life. (Bond, 1997, p. 2)

Statement of the Problem

Over the last few decades, scholars have examined the scarcity of women in science and engineering, and have begun to discuss various reasons for this shortage (Goodman & Cunninghan, 2002). In recent years, the proportion of women entering traditionally male-dominated professions has increased substantially. However, gender ratios in engineering fields have remained highly unbalanced. This situation contrasts with other traditionally male-dominated professions, like medicine, in which women constitute nearly half of all entering students (Barzansky, Jonas & Etzel, 1999).

The low representation of women in engineering is well known. Research has documented the low numbers of women in engineering and the possible barriers that have contributed to this shortage (Frehill, Javurek-Humig & Jeser-Cannavale, 2006; Margolis & Fisher, 2002; Sadker & Sadker, 1994). Most studies examining female participation in engineering have focused on recruitment. This body of research mainly addresses young women's pre-college experiences and has identified a variety of factors that impede female high school students from pursuing careers in engineering and other technical fields. These factors include: lack of support from family and teachers; limited

guidance to take advanced prerequisite courses; limited hands-on experiences with science and technology; and, recently, the impact of stereotypes upon girls (Heyman & Legare, 2004; Isaacs, 2001; Sadker & Sadker, 1994). As a result of this research, professional science and engineering organizations, along with universities have developed programs that allow female high school female to be aware of the opportunities the engineering field offers. Most of these programs are addressed to women who have shown interest and have been successful in science and math courses throughout high school. However, a large percentage of this research treats engineering as part of a larger science, technology, engineering, and math block (STEM); and fails to identify women's unique experiences in engineering colleges.

A recurring problem in engineering education is the high rate of attrition, or the rate at which students withdraw from higher education institutions without finishing a program (Forest & Kinser, 2002). Statistics show that the total attrition from engineering has always been very high (Asociación Nacional de Facultades y Escuelas de Ingeniería [ANFEI], 2003; National Science Foundation [NSF], 2000). Research on women in science and engineering has also helped determine factors that contribute to female student attrition, such as the lack of female faculty and role models, especially in engineering colleges; the hostile climate of engineering colleges; and poor teaching, especially by science, math and engineering faculty (Muller, 2005; Seymour & Hewitt, 1997; Tobias, 1990).

Studies in college student retention, which address students who remain at the same institution where they start until they complete a program (Forest & Kinser, 2002),

have found retention is influenced by individual and institutional factors such as student background; ethnicity; high school grades and SAT scores; socioeconomic status; participation in social activities, faculty; size of the institution; and attachment to the institution (Bean, 2005; Pascarella & Terenzini, 1991; Tinto, 1993). Finally, most studies focused on the persistence of females in engineering majors are based on indices like GPA or SAT scores, math and science ability, and in Mexico, performance in the entry math and science test (Universidad Nacional Autónoma de México [UNAM], 2003). These scores are used as predictors of persistence. In summary, literature examining female participation in engineering has been helpful in determining the factors that contribute to recruiting women into science and engineering, and in identifying causes of female attrition. However, research on student experiences that contribute to the retention of females in engineering programs is scarce. This study contributes to our understanding of why female engineering students remain and graduate from their programs.

Furthermore, the studies cited above do not consider the uniqueness of Mexican schools of engineering—that is, they do not take into account the cultural context of Mexican higher education and Mexican colleges of engineering. Education cannot be understood outside its own particular contexts. Social learning theories argue that learning is shaped by the particular skills and abilities that are valued in a particular culture (Jarvis, 1987; Krumboltz, 1979; Vygotsky, 1978). Jarvis (1987) explains this social dimension of learning by describing how learning is intimately related to the world in which the learner lives and by focusing on how learners are affected by this

world. Every person, Jarvis argues, is born into a society with its own established culture, which Jarvis defines as the sum of knowledge, values, beliefs, and attitudes. Individuals acquire culture through different socialization processes such as formal education (Bourdieu, 1986). Furthermore, Merriam and Caffarella (1999) explain that "what one wants to learn, what is offered and the ways in which one learns are determined to a large extent by the nature of the society at any particular time" (p. 5).

There is currently little research on the experiences of female students in higher education engineering programs in Mexican universities. The few studies that do exist take the perspective of documenting demographic changes in engineering enrollment or outlining economic growth. For instance, Noriega's (2000) study about educational policies focuses on how globalization and the job market influence higher education institutions to improve their access to technology majors. Another study by García Guevara (2002a) describes how women's roles in Mexican society influence whether they will choose engineering majors. Furthermore, García Guevara posits that the low numbers in some engineering programs such as civil engineering are linked to gender roles in Mexican society and the association of these engineering careers with male roles. In addition, most studies exploring women in engineering report quantitative statistics about women's participation and attrition (ANFEI, 2003; Ramos Lopez & Hernández Santiago; 2005; Valdés & Gomáriz, 1995) and do not capture the rich depth of understanding a qualitative study would bring to this issue. Given the limitations of the existing literature, there remains a need for research on female student experiences in engineering in Mexico. This dissertation research, then, focused on the experiences,

competencies, and strengths of women in engineering programs in Mexico that helped them remain in their programs.

Purpose of the Study

The purpose of this study was to explore why female college students remain in engineering programs in Mexico. This study sought to describe and understand the experiences of female students attending engineering colleges in Mexico and the sources of support and strategies that helped them persist in their programs.

Research Questions

The study was guided by the following research questions:

1. How does Mexican culture shape the experiences of female students in engineering colleges?
2. How does the engineering culture and environment shape the experiences of female students in engineering colleges?
3. How do institutional characteristics shape the experiences of female students in engineering colleges?
4. How do female engineering students explain their reasons for staying in and completing engineering undergraduate programs?

Significance of the Study

Higher education institutions play an important role in changing societies (ANUIES, 2000); those in developing countries present an ample spectrum of differences, particularities, and needs. In Mexico, female participation in engineering programs in general terms is only 25%, while some specific engineering programs have only 3% of women enrolled (ANUIES, 2007b). In addition, the rate of attrition in engineering is very high. Identifying the experiences that help female engineering students stay in their programs could potentially help faculty and administrators improve the conditions for female engineering students to achieve their goals.

The National Association of Universities and Higher Education Institutions (ANUIES, 1999) developed a vision for the Mexican higher education system to achieve by the year 2020. This vision takes into account the diverse perspectives of higher education institutions in Mexico, and is presented in a document entitled "Higher Education in the XXI Century" [*La Educación Superior en el Siglo XXI*]. This document proposes 14 programs to improve higher education in Mexico, one of which, "Expansion and Diversification" (p. 196), identifies the need for this dissertation research. This program is focused on increasing enrollment based on equity; and fostering more participation of students from low socioeconomic sectors, women in non-traditional programs, and students from different cultures and languages.

Operational Definitions

Attrition is the term used to describe all who withdraw from an institution without formally completing a program (Forest & Kinser, 2002).

Culture is the sum of knowledge, values, beliefs, and attitudes (Jarvis, 1987).

Gender refers to masculinity and femininity; the acting out of the behaviors thought to be appropriate for a particular sex (Rosenblum & Travis, 2000, p.1).

Nerd is a term often bearing a derogatory connotation or stereotype that refers to a person who passionately pursues intellectual activities (Wikipedia, 2008a). The equivalent of nerd in México is: [*cerebrito, matado, ratón de biblioteca, ñoño, inteligente pero debilucho*] (Wikipedia, 2008b).

Private University in Mexico is a university that is almost completely funded from private sources (Adelman & Salazar, 1995).

Public University in Mexico is a university that is almost exclusively financed by subsidies from state and federal governments (Adelman & Salazar, 1995).

Recruitment refers to the process of adding new individuals to a population, in this case adding more students to an academic program (Forest & Kinser, 2002).

Retention refers to those students who remain at the same institution where they start until they complete a program. Students who transfer to other institutions before completing a degree usually are considered not to have been retained (Forest & Kinser, 2002).

Limitations

1. This study reports on selected universities in Mexico and on the experiences and perceptions of selected female students in engineering programs.
2. This study may be limited by conditions related to the context and time of the study.
3. This study may be limited based on gender, age, educational level, and socioeconomic class of the researcher and the participants (Merriam, Johnson-Bailey, Lee, Kee, Ntseane & Muhamad, 2001).
4. I approach this study with attachment, as this subject is close to my own life. I am a female engineer who taught more than fifteen years in engineering colleges in Mexico. Although personal experience related to the situation allows the researcher to be in a better position and more knowledgeable about the experiences she is studying (Clandinin & Connelly, 2000), it also risks the researcher becoming what Michael Agar called, "not the professional stranger" and entering the research without "a detached scientific view … to formally document the experience from the perspective of a stranger" (Agar, 1996, p 252).

Contents of the Study

This study is reported in five chapters. In Chapter I, I present an overview of the research problem. I review the literature in Chapter II, starting with an introduction to Mexican higher education, its Mexican contexts, and female student participation; then I review three bodies of literature: college student retention, female participation in

science and engineering, and feminist theories that help illuminate why female engineering students in Mexico stay in their programs. In Chapter III, I describe the qualitative methodological approach used in this study. In addition, I include a description of the four higher education institutions in this study, and the participants I interviewed. In Chapter IV, I report the findings of this study. Finally, in Chapter V, I include a discussion of the findings as well as conclusions and recommendations for future research.

CHAPTER II

LITERATURE REVIEW

Introduction and Overview of Chapter

The purpose of this study was to explore the experiences of female students in engineering programs in Mexico, and to understand why they remain in those programs. In this chapter I first set the context of the study by describing the particularities of higher education in Mexico, and more specifically, the participation of women in higher education. This contextualization will help the reader to more fully understand the lived experiences of Mexican women in engineering programs that I will present in the findings chapter. Next, I examine three bodies of literature relevant to female participation in engineering programs. The first focuses on college student retention; this area of research identifies the individual and institutional factors impacting college student retention. The second focuses on the experiences of female students in engineering programs, which have traditionally had low rates of female participation. Here, I review research exploring pre-college and college experiences of female engineering students. This review highlights the importance of conducting further research examining the experiences of female engineering students. Finally, the third area of literature offers the theoretical frameworks for this study, which are feminist epistemology and gender socialization.

Enrollment in Mexican universities has grown steadily since 1970, and has doubled in the last 20 years. However, higher education in Mexico is still a privilege--only 22% of Mexicans between 20 and 24 years of age are enrolled in higher education institutions (SEP, 2000), compared with the U.S. where participation in higher education among the same sector of the population is nearly 50% (NCES, 2003).

At the same time, participation of women in higher education in Mexico has improved substantially, and has nearly achieved parity with men (ANUIES, 2007a). However, the increased enrollment of women in higher education in Mexico does not mean that the division between traditionally "male" and "female" academic programs has disappeared. For instance, in 2006, in traditionally "female" programs such as education, women represent 66% of students, and in traditionally "male" programs such as metallurgy engineering, enrollment of women barely reaches 3% (ANUIES, 2007a).

The literature on college student retention is vast. Theoretical models have changed over time, with recent models paying more attention to social and cultural factors (Astin & Oseguera, 2005). Institutions of higher education are increasingly more concerned about the persistence and graduation of their students. College student retention is related to intertwined individual, familiar, social, and institutional factors (Covo, 1988; Seidman, 2005). To study these factors, I divided the review of literature on college student retention into two categories: literature focusing on (1) individual characteristics of students, and (2) institutional characteristics and student-institution interaction that can affect student retention. Many of the factors found to affect college

student retention have also been found in studies referring more specifically to women in engineering programs.

Literature exploring female participation in engineering, an academic program with one of the lowest rates of female participation, has been useful mainly in determining factors that influence *recruitment* of students into the engineering field identifying causes of female *attrition*. However, research on student experiences contributing to the *retention* of females in engineering programs, especially in Mexico, is scarce. Many recruitment studies focus on pre-college experiences, and much of the attrition research typically consists of large quantitative or mixed methods studies conducted in the U.S. (Cooperative Institutional Research Programs [CIRP], 1996; Zastavker, Ong & Page, 2006); these studies probe factors related to why women *leave* engineering, but not why they *stay.* Furthermore, research that examines undergraduate engineering students in the context of science and engineering does not take into account the uniqueness of engineering education, and typically groups engineering with some science fields where women have already reached a higher participation rate than men. Finally, most research on female engineers in Mexico consists of quantitative descriptive statistics about female participation and attrition; there is a lack of in-depth qualitative understanding of how female students experience their engineering programs.

Mexico has experienced an explosive growth in higher education enrollment. But although women have nearly reached 50% of the higher education enrollment (ANUIES, 2007a), their participation in certain fields such as engineering remains negligible. Research in this area (García Guevara, 2002a; Goodman, & Cunningham, 2002; Isaacs,

2001) suggests that although female participation in science and engineering has been examined, less is known about female engineering students' experiences in college, and little attention has been paid to determining the dimensions facilitating their retention in these programs. This gap in literature is significant, not only because daily experiences affect the decision of female students to stay in engineering, but also because these experiences can provide guidance for educators and administrators on how to retain female engineering students.

Feminist epistemology and gender socialization offer conceptual frameworks for analyzing and interpreting women's' experiences in engineering programs (Tisdell, 1995; West & Zimmerman, 1987). Among the various political and philosophical approaches taken within feminist theories, Dentitth and Brady's (2001) cultural postmodern feminist approach acknowledges both the power relationships present in educational systems, and the agency that allows people to create social change. In addition, the social-construction-of-gender approach offers an explanation for the socially constructed division of social roles between men and women. According to this approach, the roles men and women take in society are not natural, but the consequence of cultural and social dynamics. Another frame of reference to understand the experiences of female engineering students are the challenges to women's learning theories, which presume that women tend to be more subjective and affective in their learning (Belenky, Clinchy, Goldberg & Tarule, 1997; Hayes, 2001).

Higher Education in Mexico

The particularities of higher education in Mexico are described as a framework to understand the complexities female engineering students face in their daily lives within academic programs, and how these complexities affect their experiences as students. In past decades, female participation in higher education in Mexico was very low. This phenomenon was associated with socio-cultural stereotypes that established Mexican women as mothers and wives and identified them as emotional and affective, and therefore not "fit" for schooling; this ultimately has kept them from paid work and formal education. Therefore, the characteristics of Mexican educational institutions not only affect the experiences of female students, but also stress traditional roles of women and thus present challenges for women who venture into non-traditional fields (García Guevara, 2002b).

Despite this, participation of women in higher education in Mexico has increased substantially in the last three decades and has nearly achieved balance with male participation, as stated before. However, gender parity has not been reached for all academic disciplines. Some colleges such as engineering are traditionally seen as masculine, meaning that most of the students are male, while others like education and nursing are seen as feminine because most of the students are female (ANUIES, 2007a). According to Bustos (2003), enrollment in traditional "feminine" programs is due in part to the domestic functions associated in society as women's roles, and the possibilities of participants in these professions to balance work and family. This not only reinforces

stereotypes about women's roles, but also undermines women's welfare because traditionally "feminine" programs have less social prestige and offer lower salaries.

History and Participation

Latin American universities are patterned on European models (Husén, 1996). More specifically, the university in Mexico is based on the French model, which influenced the autonomy movement in Mexican universities in the 1920's (Soto-Lescale, 2002). Higher education in Mexico reflects the social aspirations of the nation, and recognizes the power of education, as it advocates for a social education. In addition, higher education in Mexico has traditionally been linked to addressing and solving social problems. Higher education programs have been developed to extend the benefits of science, technology, and culture to society; and to help less privileged social classes (Piñera-Ramirez, 2002).

Higher education in Latin America was organized in the 19th century, when most Latin American countries obtained independence from Spain and other colonial powers. Historically, the Catholic Church was the founder of colleges in Mexico (which was New Spain at the time), as part of Spanish colonization. The struggle for political independence was manifested in ideals of secularism, appreciation for technical knowledge, and a general discomfort with traditional universities (Schwartzman, 1996). Many of these early colleges were transformed into the current secular public universities, for example the first university in Mexico, *Real y Pontificia Universidad de la Nueva España* (Royal and Pontificial University of New Spain), founded in 1551, became the *Universidad Nacional Autónoma de Mexico* (National Autonomous

University of Mexico) in 1910 (Soto-Lescale, 2002). According to the constitution, education in Mexico is supposed to be secular. While all public universities are secular, there are still some private Catholic universities such as Universidad Iberoamericana and Universidad Panamericana, reflecting Mexico's religious tolerance in education.

Mexico's higher education institutions are either private or public, depending on their sources of funding. Private institutions do not receive government funds but instead are financed by tuition, projects, and funds from their Boards of Directors. In contrast, public education is almost totally funded by federal and state money. Tuition in public universities is typically minimal (symbolic), although it is becoming difficult for the government to support the growth of higher education and to maintain its quality. In 2006, public institutions served 68% of the total college student population in the country (ANUIES, 2007b). Private education is based on market theory; public education is based on the idea of equal opportunity. Nevertheless, both types of institutions have been challenged by the pressures of the market (Ireta, 2003).

Enrollment in higher education in Mexico grew slowly for the first 150 years (Soto-Lescale, 2002); however, higher education experienced a period of explosive growth in the 1960s and 1970s, and leveled again during the 1980s and 1990s. According to ANUIES (2003) in 1970, 214,987 students were enrolled in higher education, representing 0.05% of the total population between 20 and 24 years of age. In 2000 total enrollment in higher education was 1,678,360 representing 17.24% of the country's population 20 to 24 years old. Figure 1 illustrates the growing enrollment in Mexican higher education from 1970 to 2000.

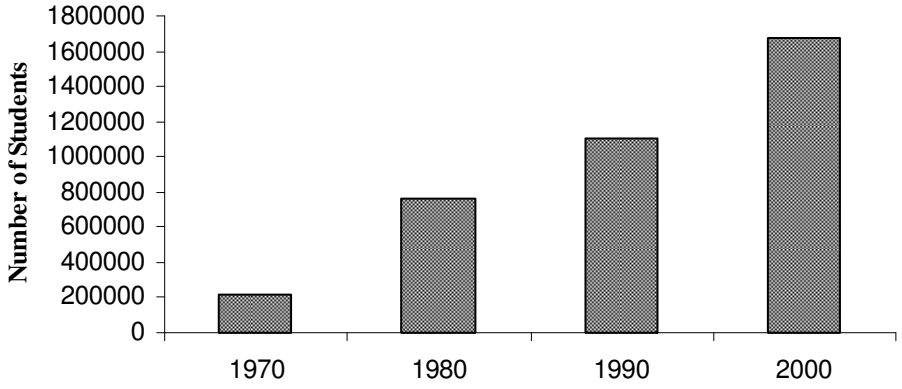

FIGURE 1. Mexican higher education enrollment 1970-2000.

Between 1980 and 2000 total enrollment in universities in Mexico doubled, and it continues to increase (ANUIES, 2003); however, today only 22% of Mexicans between 20 and 24 years of age has access to higher education (SEP, 2007). This rate of participation is still far lower than the U.S. rate of youth participation. In other words, higher education in Mexico is a privilege for few people, contrasting with higher education in the U.S. where nearly half of the population between 20 and 24 years of age has access to some type of higher education (NCES, 2003.) Figure 2 shows the percentage of the total population between 20 and 24 years old enrolled in higher education in Mexico and the U.S.

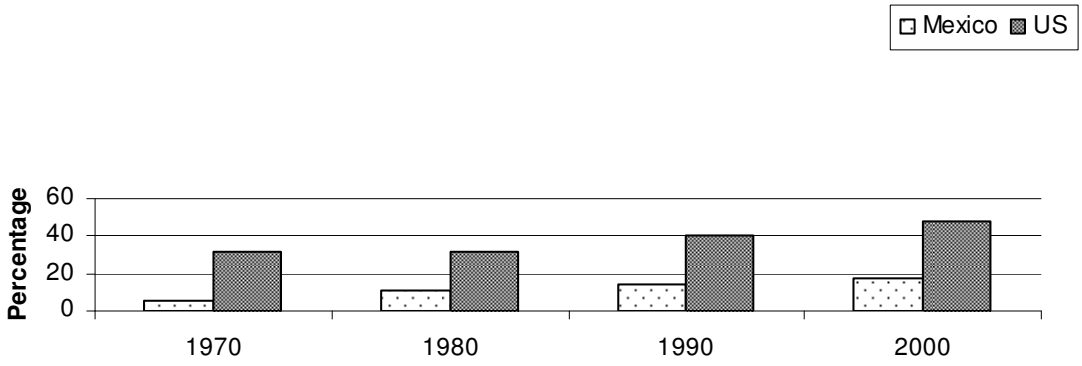

FIGURE 2. Comparative percentage of the 20-24 years-old population enrolled in higher education in Mexico and the U.S. 1970-2000.

In addition, the number of higher education institutions in Mexico has also grown steadily. According to The National Center for Validity (*Centro Nacional de Valuación* [CENEVAL], 2005), in 2005 there were nearly 2000 institutions of higher education, divided into different categories ranging from autonomous public universities to private institutions with no official certification. Due to the growth in the school population and higher education institutions and to the increased pressure on educational resources, educational authorities have implemented new laws and educational reforms designed to deal with these expansions and to improve the quality of higher education in Mexico (Rolwing, 2006). ANUIES has played an important role in educational reform in México, working with governmental offices and committees on education policy. ANUIES is comprised of 149 of the leading public and private higher education institutions representing 85% of Mexico's higher education students (ANUIES, 2007b).

Women's Participation in Mexican Higher Education

Although education in Mexico has not reached all people, educational opportunities have improved for women in Mexico. The National Institute of Statistics, Geography and Information (*Instituto Nacional de Estadística, Geografía e Informática* [INEGI] reported that the percentage of women 15 years of age or older without any formal education decreased from 35% in 1970 to 11.6% in 2005. The number of women 15 years of age or older participating in secondary schools also increased from 3.9% in 1970 to 18.5% in 2005 (INEGI, 2006).

In 1990, for the first time in the history of secondary education in Mexico, the percentage of women enrolled in secondary education achieved parity with men's enrollment, a trend that has continued to the present and has permeated higher education. Data from 1990 to 2000 on undergraduate and graduate higher education programs revealed that women's enrollment had increased in almost every academic program. Figure 3 illustrates the percentages of women and men enrolled in higher education from 1970 to 2000 (ANUIES, 2000).

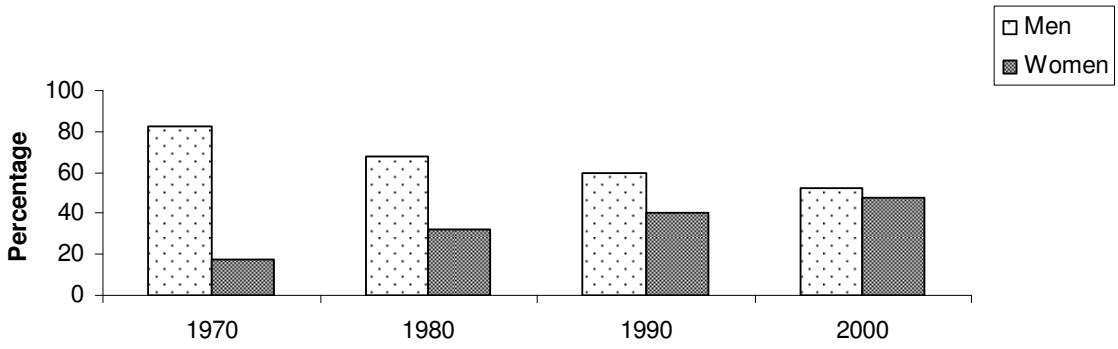

FIGURE 3. Percentages of men and women in higher education in Mexico 1970-2000.

In the last twenty years there has been a similar rise in the enrollment of women in higher education worldwide. This progress is due in part to the UN's role in raising consciousness about women's rights and about the need to improve women's access to education at all levels (Bustos, 2003). A detailed UNESCO (1998) analysis of world higher education revealed different socio-cultural and economic contexts. In general, women's enrollment has risen, and in some countries it is greater than men's enrollment. In addition, some nations have made a commitment to improve access for women to higher education. In Mexico, in 2002, the National Institute for Women (*Instituto Nacional de las Mujeres*) signed "agreements" with the ANUIES and the Public Education Secretary (SEP) to incorporate gender perspectives in higher education institutions. The signing of these agreements revealed that in the Mexican academic context there are cultural inequities between men and women and that there is a conscious institutional-based effort to end these inequities (Palomar, 2004).

Bustos (2003) argues that re-considering enrollment in higher education in Mexico in favor of women has positive educational, economic, and social impacts. From an economic point of view, individuals with higher levels of education have better employment prospects. In Mexico, individuals who hold a higher education diploma are ten times more likely to find a job those who do not (Katz & Correia, 2002). A report by the National Institute for Women shows a rise in female participation in the workforce from 17.6% in 1970 to 42% in 2000. However, women dominate occupations such as health, education, and catering, which have lower status and pay than more male-

dominated fields; women also largely outnumber men in jobs in private households (SEIG, 2004).

Women now have a significant presence in higher education, having reached parity with men. Although more women are entering all areas of study, however, there continue to be more women entering liberal arts, social science, and health programs than other programs. However, the high percentage of females in health sciences is greatly influenced by the large numbers of women who pursue nursing in particular. In contrast, according to ANUIES, the total enrollment of women in engineering programs in Mexico is only 24% (ANUIES, 2007a).

Female enrollment in traditionally "feminine" programs is due in large part to the opportunities these professions hold for flexible work schedules. These fields allow for a variety of professional jobs in private offices, laboratories, and the health sector, allowing women to combine family and career (García Guevara, 2002b). The choice of liberal arts programs by women is shaped by the social construction of gender established by a patriarchal society. Traditionally, in Mexican society, women hold family and domestic functions, while men are responsible for the economy. However, the dual salaries resulting from the increased participation of women in the labor force contrasts with these more traditional roles (García Guevara, 2002b).

In Mexico, female enrollment in traditionally masculine programs has grown very slowly in some areas, and more quickly in others. Noriega (2000) argued that the increase in women's enrollment in traditionally masculine programs is due to (a) changes in economic, technological, and professional market conditions, (b) changes

in gender relationships, (c) more opportunities in education, (d) demographic growth, and (e) state politics. Changes in the economy, even in contrast with traditional divisions of labor, contribute to the increase in enrollment in some majors. Similarly, the increase in offerings of educational programs is influenced by technological advances and market pressures.

In some traditionally masculine programs in Mexico, statistics show that the percentages of women and men have reversed. For example in 1980 in social science, men constituted 62% of the student population, while in 2006 they were only 39%. However, there is no traditionally feminine program where the percentage has reversed; in contrast, these differences are actually now stronger. For example, in liberal arts programs, men represented 43% of the students in 1980, this number decreased to 38% in 2007 (ANUIES, 2003; 2007a).

Now that I have set the context of the study describing the particularities of higher education in Mexico, and the participation of women; I will review three bodies of literature relevant to women's experiences in engineering programs: college student retention, female students in engineering, and the social construction of gender and feminist theories as a theoretical framework.

College Student Retention

Student retention is one of the most widely studied topics in higher education in recent years (de los Santos, 2004; Tinto, 2005). Researchers have focused on understanding why some students leave and others persist. Much empirical research on

degree completion focuses on the development and testing of theoretical models. Astin and Oseguera (2005) describe how these models are diverse and have changed over time, ranging from status attainment models popular in the1970s, to holistic models popular in the 1980s where pre-college attributes and college experiences were studied, to comprehensive studies integrating different theoretical models for different groups popular in the 1990s. In addition, in practice institutions are responding to the challenge of increasing student success. Retention rates in many cases reflect the pressure of states to include graduation rates as a measure of accountability. In other cases retention impacts the ranking systems that include these rates as a measure of quality. Whatever the reason, leaders in institutions of higher education are increasingly concerned about the persistence and graduation of their students.

Bean (2005) describes how student retention can be studied from different perspectives including theoretical models that propose factors linked with the decision to remain in college or leave; policy perspectives where government and other policy agencies suggest how different types and amounts of funding affect retention; institutional perspectives that focus on the effectiveness of retention programs in individual institutions; and individual perspectives that consider how student behavior, background, and attitudes interact and affect retention decisions. Retention and, consequently, attrition are related to intertwined individual, familial, social, and institutional factors (Bean, 2005; Covo, 1988; Tinto, 2005). A review of college student retention literature reveals how complicated the path to graduation is for some students. Together with academic performance, factors such as income, race/ethnicity, gender,

type of institution, faculty, and social integration, among others, have proven to influence college student retention.

To review the factors impacting student retention in college, I divided the literature review into two categories. First I present literature examining individual characteristics of students. Next I present literature on institutional characteristics and on student-institution interactions that affect student retention.

Student Characteristics

Researchers have found that the likelihood of an individual graduating from college is influenced to a high degree by their individual backgrounds (Bean, 2005; Pascarella & Terenzini, 1991; Tinto, 1993). Bean (2005) proposed nine different factors related to college student retention. One of these factors focuses broadly on individual characteristics of students, and includes many aspects of a student's background, including focus on educational goals; high school grades; class rank; standardized test scores; parents' occupations; education; and income. Ethnicity and age are also considered important factors in student retention (Pascarella & Terenzini, 1991; Tinto 1993). Research has shown that test scores and high schools grades are among the strongest predictors of student graduation (Astin & Oseguera, 2003; Pascarella & Terenzini, 1991; Tinto 1993). Astin and Oseguera's national longitudinal study (2005) found that looking at graduation in four years; students who enter college with A-grade averages in high school are seven times more likely to finish college than students with C-grade average or less. However, some research shows that these factors are not such strong predictors of degree completion for non-white students (Fleming & García, 1998).

Research in the U.S. (Astin & Oseguera, 2005; Nora, Barlow & Crisp, 2005) has revealed that women are more likely than men to attain a bachelor's degree. This research suggests that women engage in different academic and social activities that impact retention. In addition, this research reveals that this pattern reflects factors such as financial status and support networks that encourage female student retention. Similarly, in Mexico, the graduation rate for women in 2001 was 54%, contrasting with only 46% for men (de los Santos, 2004).

Bean (2005) argues that factors influencing retention can be substantially different for diverse groups of students. Statistics (NCES, 2003) also show that graduation rates are different among various racial ethnic groups in the U.S., with Asians having the highest graduation rate, achieving nearly 70%, and Hispanics having the lowest rate, with only 28.8%. Bean (2005) also makes demographic distinctions in student retention for minority students. For example, he argues that being Hispanic or African American may be correlated with higher levels of attrition at certain institutions; however he states that this situation cannot be stated as a cause for leaving. A chilly or hostile racist environment can result in minority students feeling that they do not fit within the institution, and these feelings can lead to attrition. He also argues that minority students may come from high schools that may not have prepared them well for college; thus he argues that academic ability, not race, is the cause for students' attrition.

Intact, affluent and well educated families can positively affect student retention. Money and finance can affect retention in many different ways. Bean (2005) argues that running out of money is one of the most common causes of student attrition. However,

many students who actually leave college for various non-financial reasons cite finances as the reason, because placing blame on finances removes blame or responsibility from the student's own academic or motivational failure. A second factor to consider is that students whose parents can finance their higher education also typically possess high levels of cultural capital (Bourdieu, 1986). Students from high socioeconomic classes have higher retention rates because those students have educational and cultural advantages. In addition, those students do not need to work to earn money, so they can therefore fully participate in the social life of college. Tedesco's (1987) analysis of Latin American student retention found that socio-cultural characteristics of low income families determine expectations and attitudes that do not promote academic success. Additionally, the value given to education varies substantially among different social classes. Covo's study at UNAM (National University of Mexico), cited by de los Santos, posited that social class is the strongest student background predictor of academic success (de los Santos, 2004).

According to Bean (2005), another accepted reason for leaving college is academic performance, which is usually based on grade point average (GPA). Tinto (1975) distinguished between involuntary and voluntarily departure from college. A student can be dismissed by the college or voluntarily depart due to a low GPA. Some students are not capable of the academic performance required for their majors. However, Bean (2005) states that academic performance is not only a matter of ability, but can be associated with other factors such as interaction with faculty members and

advisors, attitudes toward education, sense of academic self-efficacy, interest in the courses offered by the college, and loyalty to the school.

Fishbein and Azjen's 1975 model, as cited in Bean (2005), states that "intentions to behave in a certain manner precede that behavior" (p. 218). Bean (2005) found that another good predictor of student departure from college is the intent to leave or stay. Since most students who attrite do so at the end of the freshman year, the effect of this variable decreases with time. This variable alone does not fully explain why students leave. However, Bean states that intentions are "the by-product of the interaction of the student and the institution, especially the faculty, other students, administrators, and staff members" (p. 219).

Bean (2005) identified three psychological processes that influence student retention: self-efficacy, approach/avoidance, and locus of control. Self-efficacy refers to students' beliefs in their abilities to succeed in the academic environment and to achieve their goals; as a result they increase their self-confidence in finishing college. Approach and avoidance are ways of dealing with the environment and determine which activities to approach and which to avoid. For example avoiding excess in alcohol and eating and approaching academic activities such as learning to use the libraries or attend workshops provides skills that can result in positive image and positive attitudes about college. Students with internal locus of control believe they are responsible for the actions they decide to take. They believe good grades are the result of good study habits. In most cases internal locus of control leads to improved academic performance, an increased sense of self-efficacy, and positive attitudes toward the institution. In contrast, students

with external locus of control believe the actions they take do not influence the results they obtain. For example, they believe good grades are the result of luck. However, when the grading process is discriminatory, for example when an African American receives a low grade for what is actually a quality work, a student's perception of external locus of control is accurate and can lead to negative attitudes towards the institution and intent to leave.

In addition to these psychological processes, attitudes can play an important role in retention. Sense of satisfaction with being a student, sense of self-development, and self-confidence as a student are attitudes that are related to each other, to institutional fit, and consequently to intent to stay. Being competent with academic work, confident that one can obtain good grades, and enjoying these competences can increase student retention (Bean, 2005).

Another attitude Bean (2005) has found significant in student retention is a student's perception of the practical value of education that comes from learning skills that will provide access to jobs. Additionally, a student's way of dealing with stress can affect retention. While low levels of positive stress can provide motivation, high levels of stress can have a negative influence on retention.

Finally, other forces that can influence student retention are significant others, opportunities to transfer, work, and family responsibilities. Astin and Oseguera (2005) found that students who work full time or work off-campus have worse retention rates than students who work part time on-campus.

In this section I presented the literature examining individual characteristics of college students than can affect retention. In the next section I present literature analyzing student-institution interaction and institutional characteristics that can affect student retention.

Institutional Characteristics and Student-Institution Interaction

Research (Bean, 2005; Berger & Lyon, 2005; Tinto, 1975; 1993) has shown that social integration is a pillar in the retention process for college students. Many factors affect the social lives of college students. The expectations held by parents, siblings, and high school friends; and the information a student receives from these people, can affect a student's interaction with the institution. In addition, positive relationships with faculty, and particularly with other students, can lead to satisfaction, self-confidence, loyalty and ultimately remaining enrolled. The social life of students has proven to be important to retention (Bean, 2005). Similarly, Astin and Oseguera (2005) proposed that students who show a propensity to become involved in the social and academic life of the institution have better chances of finishing college.

Bean (2005) refers to the role of student services offices in retention as a "bureaucratic factor." This term, one of nine of Bean's themes of college student retention, describes the ways formal exchanges of resources like time, money, effort, and information between the student and the institution take place. Interactions between students and service programs can include exchanges of information about participation in admissions, financial aid, application processes, housing, orientation, registration, major requirements, recreational and athletics programs, social events, etc. All of these

interactions represent opportunities for staff to affect student attitudes toward the college. How students feel about the bureaucracy of a school has an effect on their alienation, attitudes toward college, and graduation.

Bean (2005) found that attachment to the institution, or fitting in with other people at a college and with a specific institution, is important for retention. If students, especially those from different cultural and social backgrounds, believe they are discriminated against because of race, ethnicity, gender, or socioeconomic status, they are less likely to feel they fit in an institution and are therefore more likely to leave college.

Bean (2005) also states that faculty members are the most influential group of university employees in shaping the psychological processes and attitudes that can affect retention:

> Faculty members' in-class and out-of-class contacts with students affect the students' sense of fitting in, loyalty, institutional quality, satisfaction, sense of self-development, self-confidence, and self-efficacy, the connection between course work and later employment, and stress. (p. 223)

The institutional characteristic that has the strongest effect on student retention and completion of the bachelor's degree is the selectivity of the college. The more selective the college, the better the chances a students will graduate (Astin & Oseguera 2005; UNAM, nd). Finally, in both Mexico and the U.S., public universities have lower retention rates than private institutions (Astin & Oseguera, 2005; Sistema de Educación Superior, 2005).

After describing the literature on college student retention, I now turn the discussion to the second body of literature which addresses the experiences of female students in engineering.

Women in Engineering

The proportion of women entering many traditionally male-dominated professions has increased substantially in recent years. In both Mexico and the U.S., nearly 50% of the students entering medicine and law are females (ANUIES, 2000; National Science Foundation [NSF], 2000). However, in the field of engineering, the percentage of women remains highly unbalanced, with women representing less than 24% of engineering majors in Mexico (ANUIES, 2007a).

Pre-college Experiences

Because of low rates of participation of women in engineering, efforts have been directed towards increasing the numbers of females enrolled in engineering programs (Isaacs, 2001; Margolis & Fisher, 2002, Sadker & Sadker, 1994). Bowen (1998) argues that decreasing interest in engineering could cause faculty shortages and in the long term result in fewer engineers in the profession. Since approximately 75% of engineering degrees are awarded to white males, Bowen recommended steps to recruit women and minorities into the profession. He concludes that recruitment of female engineering students should start in earlier stages of education.

Many researchers have focused on female students' pre-college experiences (Cannon & Lupart, 2001; Isaacs, 2001; Margolis & Fisher, 2002; Romkey, 2007; Sadker

& Sadker, 1994) and have identified a variety of factors that inhibit young women from pursing careers in science, engineering and technical fields. These factors, which are discussed below, include: lack of support and confidence in mathematics and science, limited guidance for taking advanced pre-requisite courses, and limited hands-on experiences with science and technology.

Professional engineering organizations (Association of Computer Machines [ACM], National Science Foundation [NSF], Women in Engineering [WIE]), and schools of engineering, have developed outreach programs to attract young women to the profession. A major strategy in the recruitment of women into engineering is to make female high school students aware of the opportunities engineering offers. Margolis and Fisher (2002) argue that university efforts such as summer programs addressed toward high school female students have been successful in helping young women become interested in engineering. Furthermore, studies have suggested that these programs have had greater impacts on female students than on their male peers (Fletcher, Newell, Newton & Anderson-Rowland, 2001). However, most of these efforts are directed toward students who have already demonstrated interest in mathematics and science.

Part of the problem is that girls and boys are encouraged differently and are given different career information in high school. Sadker and Sadker (1994) point out a connection between self-esteem and achievement in math and science. They describe a process called “short-circuitry” which results from the different ways boys and girls are treated. They argue that teachers and parents make the effort to teach boys to deal with academic difficulties, which makes them feel capable of doing things and builds their

self-esteem. On the other hand, when girls experience difficulties, teachers and parents tend to do things for them, thus limiting their opportunities to learn and build self-esteem. Girls' expectations are biased by attitudes in which poor performance by boys is associated with lack of effort while poor performance by girls is attributed to lack of ability. Isaacs (2001) stated that boys learn to grapple with difficult subjects like calculus until they master them, while girls learn to give up. Girls who do well are exceptional in their capacity to persist despite subtle negative messages. Bevan (2004) found that the difference in attitudes towards mathematics between boys and girls is still very large. Boys tend to express higher expectations of success while girls continue to be uncertain in their abilities, even after obtaining good grades. This issue of confidence is serious since confidence is found to be related to achievement.

Some scholars (Goodman & Cunninghan, 2002; Sadker & Sadker, 1994) have argued that young women do not major in engineering because they do not take the required advanced courses in mathematics and physics in high school. However, according to NSF (1996), this gap is closing. Research has shown that high school academic preparation does not explain completely the differences in the enrollment of men and women in engineering (Frehill, 1997). Women's lack of experience with technology and machines may refrain them from choosing the field. Margolis and Fisher (2002) studied computer science majors at Carnegie Mellon University; both student self-reports and teachers' experiences revealed that men entered the program with more experience with computers and technology. Although women generally performed well, they found it stressful to be in the same course with students who were more

experienced, and also tended to struggle in advanced courses. Carnegie Mellon's first intervention was to institute a curricular change that allowed first-year students to enter different courses depending on their level of experience. For example, in computer science, students taking an extra semester were able to gain programming experience in order to have equal opportunity in advanced courses.

Some researchers (Goodman & Cunningham, 2002; Romkey, 2007; Seymour & Hewitt, 1997) have argued that young women often enter engineering because of encouragement they receive from family members or teachers, based on their ability in math and science. However, the Women Experiences in College Engineering study (Goodman & Cunninghan, 2002) stated that the general public has an unclear concept of what engineers do, and argued that because engineering is absent from the K-12 curriculum, students do not consider engineering as a potential field when choosing college majors or careers. Isaacs (2001) posits, "the solution of the missing women engineers is clear" (p. 90). She argues that women are missing because of the poor image of the engineering profession, a lack of knowledge of what engineering is, and a misguided emphasis on math and science by recruiters. These problems make young women think engineering is not for them. Educating the public about what engineering is and making them aware that engineering is more than "math and science" will result in more fruitful efforts to recruit young people. Supporting this idea, some universities are launching programs that engage middle and high schools students and their teachers with science. For example, the Cornell Science Inquiry Partnership (CSIP) is a program involving graduate fellows working with science teachers in grades 7-12 in rural and

urban schools in upstate New York. According to its mission, "…through CSIP, middle school and high school students are engaged in three types of inquiry: (1) open-ended explorations of unexplained phenomena, (2) highly structured investigations that proceed toward known outcomes and are designed to teach specific concepts or principles, and (3) activities that lead to an understanding of the nature of scientific research" (CSIP, nd, p. 1).

Bennet (1996) took a different approach, as she studied the experiences of five 17-year old female pre-engineering students in a mechanical engineering program in New York who were considering engineering as a career. The program included many aspects research has found to be useful in attracting girls into engineering programs, such as collaborative work, hands-on experience, and a variety of teaching methods. However, interviews with female students in the program revealed that despite the curricular innovations of the program, they did not feel part of the culture of the classroom. Although many of these women were strong-willed and talented, at the end of the program many were "tired of fighting to be recognized or disenchanted with engineering as a whole" (p. 10). They experienced cultural and psychological pressure that convinced them to avoid pursing engineering. The students experienced many types of conflict in this program, including conflicts in their day-to-day interactions with male peers, which included feelings of isolation and marginalization; conflicts in acquiring the knowledge and technical experience required in their programs, and in applying their approaches to design and technology; and, finally, conflicts over their need for

validation. These conflicts, according to Bennet (1996), help explain the psychological and socio-cultural barriers that distance girls from engineering.

More recently, female engineering students who were participants in Romkey's (2007) study identified identity and gender stereotypes as challenges in choosing and pursuing an engineering major. Responding to questions about the struggles to recruit women to the field of engineering, participants discussed the issue of how engineering is perceived as "unfeminine" by society, and argued that this perception can negatively affect students' identities. Data also indicated that there is much work to be done in challenging negative stereotypes faced by female engineering students. Students specifically stated that perceived differences between the math and science abilities of men versus women are still prevalent in society, and pointed out how occupational stereotyping has a negative effect on children's and teenagers' perceptions of women in engineering. While the participants in Romkey's (2007) study remained in the field of engineering, the issues they raised could potentially negatively affect the retention of other students as well as the attitudes of female students towards the field of engineering. The process of identity development, according to the author, is individualized, but is also situated in society, which holds specific norms and values. The author concludes that her study did not account for the diversity within each gender group, and in order to encourage more girls into science and engineering we must understand how not only gender, but also class, race and other factors influence students' identities.

Pre-college engineering and science experiences for girls have been widely explored, and many actions have been taken in order to attract more women into the

field. However, few studies explore women's experiences in engineering colleges and the dimensions of those experiences that help them stay in programs.

College Experiences

Although studying the recruitment and retention of women in early educational stages has helped increase the number of women entering engineering programs, this approach ignores women's unique experiences in engineering colleges, which might explain why they stay in or drop out of programs. In addition, we must examine why women who enter college with an interest in engineering do not finish.

Daniels (1988) stated that the lack of women in engineering needs to be addressed not only by focusing on recruitment, but also by examining retention. She suggested strategies that have been used successfully, such as seminars for first year students, test anxiety management, activities that raise self esteem, and role-model alumnae discussions on their student experiences. However, as Daniels suggests, the processes of recruitment and retention depend upon cooperation between administrators and faculty to create a supportive environment for women students.

A supportive environment is important for optimal achievement in any field. The climate of engineering for women has been raised as one important aspect of women's experiences. Several studies (Anderson, 2002; Clark, Revuelto, Kraft & Beatty, 2003; Romkey, 2007) have explored how women's educational experiences differ significantly from their male peers. One study that explored gender and achievement-related beliefs argued that female engineering students face a social climate that contains negative stereotypes about women in technical fields. When female students know they are being

judged in terms of stereotypes, this can cause them to question whether they belong to the field of engineering (Heyman, Martyna & Bhatia, 2002). Teachers, from kindergarten to high school, play a role in the low interest of girls in science and engineering; this trend continues in college. Levenson (1999) used videotaping methodology to show that professors paid more attention to male students, often ignoring women's questions and suggestions. Dagg and Thompson (1988) described situations in universities in Canada where bias against women, misogyny, harassment, and gender inequality were present. For example, some faculty still used sexist language, and some joked about sexism and told sexist jokes. Some faculty even failed to recognize women at all. The role of gender in the classroom impacts and sometimes defines women's experiences. While referencing adult education specifically, Weiss (2001) makes a statement that also applies to gender issues in colleges of engineering:

> Although men don't necessarily dominate a classroom in terms of talking time, they're often perceived as having more power and knowledge. When men talk, people tend to pay more attention ... Examples of discrimination persist in adult education--such as calling directly on men students but not on women, responding more fully to men's comments than to women's, and interrupting women students more often. (p. 46)

Women as minorities often feel isolated in engineering. One theoretical foundation for student retention contends that students "learned by becoming involved" (Pascarella & Terrenzini, 1991, p. 50). This theory is based on the notion that student involvement is achieved with investment of psychological and physical energy in tasks

and activities. If students do not feel connected and involved within their environment, it is likely they will not be retained (Johnson & Johnson, 1993). For years, engineering educators have tried to engage students through learning communities, team projects, and cooperative education (Clark et al., 2003; Johnson & Johnson, 1993). However, a 2003 NSEE report stated that engineering students still have low levels of student-faculty interaction and supportive campus environments.

Anderson (2002) argues the need to think about engineering education through the lenses of good teaching. Research has found that students often cite poor teaching, especially in science and technology courses, as a strong factor for leaving their majors (Duncan & Zeng, 2005; Seymour & Hewitt, 1997). Students argue that engineering professors do not answer their questions, and tend to delegate them to student teachers. McShannon and Derlin (2000) suggest that learning styles are different among the various subgroups, including male and female, white and minority, and freshmen and seniors, of their 515 undergraduate engineering students' survey. Although most of the students tend to learn by themselves, some benefit from learning with other students or with faculty in informal settings. While traditional instructional strategies appear to support typically successful students in engineering, these strategies may fail to provide the needs that diverse students have to achieve positive outcomes. Finally, Felder and Spurlin (2005) discuss students' differences in motivation, attitudes toward learning, and responses to instructional practices. The authors argue that although much has been written about students' learning styles, approaches to learning, and levels of intellectual

development, very little of this research has been conducted in the context of engineering education.

Positive role modeling has been identified as an important key to building a career. Anderson's (2002) qualitative case study of women in undergraduate engineering programs identified inadequate counseling and advising as major barriers to students' satisfaction or success. Because of low numbers of female faculty, the lack of female role models may increase the problem of low numbers of women in engineering. Some researchers (Ivey, 1988; Tidball, 1986) have found that institutions with a great number of women have a greater proportion of women becoming scientists, and this can influence persistence in the field. In contrast, other researchers argue that in certain disciplines the representation of more women does not always lead to more female students or long term retention (Etzokwits, Kemelgor, Neuschatz, Uzzi & Alonzo, 1994).

Although most female engineering students experience a male-oriented environment, many have succeeded in this environment. Some studies address female engineering students' experiences in college; however, little attention has been focused on determining the elements that facilitate success in this environment. Most of the studies that do exist are based on surveys and interviews about the negative experiences of women in engineering program environments. Few studies have asked students to share their experiences and study the dimensions that help them stay in programs. In Mexico, most studies of women in engineering refer to statistics of female participation and enrollment. A qualitative study by García Guevara (2002a) at the University of

Guadalajara described the role of globalization and market in women's enrollment in engineering programs, and revealed the need to develop more studies about women's participation in engineering programs.

The last section described below offers the theoretical framework for this study exploring feminist theories and gender socialization.

Theoretical Framework

For this study, I draw from the theoretical frameworks of feminist epistemologies, gender socialization, and feminist pedagogies to analyze and understand the experiences of female engineering students in Mexico. Feminism means different things to different scholars, and there are multiple definitions of the movement that started as a political call for women's rights and equality (Merriam & Caffarrella, 1999). Tisdell (1995), for instance, describes three different categories of feminist theories ranging from liberal feminist theories that focus on women as individuals; to structural feminist theories that focus on societal structures affecting women; to post-structural feminist theories that consider, in addition to societal structures, individual power, control, and capacity for action. More recently, Boxer (1998) described how feminist research positions gender along with race, sexuality, class and other positionalities; and considers how power relations in society and the experiences of women affect individual and social change.

An important consideration for examining the low representation of women in engineering is the concept of gender socialization. Culturally determined belief systems

about masculinity and femininity create different expectations and norms for people of each sex, and these belief systems also pressure individuals to conform to gendered roles. West and Zimmerman (1987) discuss how men and women act according to a perceived masculine and feminine division, which is not natural, but socially constructed. Their concept of "doing gender" focuses on how enacting culturally prescribed gender roles reproduces and legitimates gender categories. Research specifically focused on engineering (Frehill, 1997; Romkey, 2007; Sadker & Sadker, 1994) argues that engineering education "does gender" by encouraging and reproducing masculine cultures in the colleges.

Finally, to better understand the experiences of Mexican female students in engineering colleges I draw from feminist pedagogies, which are concerned with the educational needs of women and with increasing the status of women in society. More specifically, I focus on Dentitth and Brady's (2001) critical postmodern feminist theory as a pedagogical tool that recognizes the "power relationships that exist in the educational system" (p. 170) and acknowledges differences that allow people to create social change. This theory focuses on structural sexism and oppression, but also recognizes individual agency. In conjunction with critical postmodern feminist pedagogy as a frame of reference to better understand the experiences of female students in engineering, I also used various feminist challenges to traditional female-centered learning theories. I discuss how the literature on women's learning has reinforced stereotypes about women as learners, and has over-generalized the differences between

men's and women's learning, while not paying enough attention to how educational settings reinforce gender stereotypes.

Feminism

Feminism refers to a philosophical and political perspective rather than a gender or biological sex, and it is not limited to the liberation and oppression of women (Schiebinger, 1999) but includes all oppressed groups. Feminism, then, becomes a strategy to end oppression (hooks, 1984), whether that oppression is based on biological sex, gender, or some other positionality such as race, class, or sexual orientation. However, some theorists (Flax, 1997) have argued that the main goal of feminist theory should be the analysis of gender relations:

> A fundamental goal of feminist theory is (and ought to be) to analyze gender relations: how gender relations are constituted and experienced and how we think or, equally important, do not think about them. The study of gender relations includes but is not limited to what are often considered the distinctly feminist issues: the situation of women and the analysis of male domination. (Flax, 1997, p.171)

To develop an understanding of feminist theory in education, Tisdell (1995) divides feminist theories into three categories. The first category consists of feminist theories with an individualistic focus and includes liberal feminism and psychoanalytic feminism. Liberal feminism is concerned with helping women as individuals gain access to systems men have always had access to, and focuses on giving women equal opportunities with regard to education and the job market. One critique of liberal

feminism comes from women of color, who argue that the focus of feminism has been historically and primarily on white-middle class women, and that liberal feminism considers women as a unique category that is implicitly white and middle class. Psychoanalytic feminism also has an individual focus, but from a psychological point of view. This type of feminism focuses on gender socialization, and the idea that a patriarchal system reproduces itself because of conscious and unconscious mechanisms through which gender socialization occurs. For example, psychoanalytic feminism analyzes individuals' unconsciously internalized patriarchy. Although psychoanalytic feminists recognize the influences of the system, their main concern is based on change for woman at the individual level. This theory has also been critiqued because it focuses primarily on white middle-class women.

Tisdell's (1995) second category, structural feminist theories, refers to theories "that are primarily structural focusing on examination of societal structures that affect women" (p. 46). Theories in this category include radical feminism, Marxist feminism, and some forms of socialist and Black feminism. Radical feminism's focus has been on patriarchy and the idea of changing social structures; this contrasts with liberal feminism whose goal is simply for women to have access to the system. On the other hand, for Marxist feminists there are two systems that oppress women: patriarchy and capitalism. Marxist feminists argue that in order to change the oppression of women, capitalism and patriarchy both must be changed. Socialist feminism has a strong relationship with Marxist feminism; both agree that capitalism and patriarchy are inter-related systems that collude in the oppression of women. However, socialist feminists insist on

examining other systems of oppression such as race, and also focus on the intersections of gender, race, and class. In all cases these structural feminist theories deal primarily with structural systems that affect women's lives, "…and tend to focus on how power relations are reproduced by social structures in the system" (p. 47).

The third category proposed by Tisdell (1995) includes post-structural and postmodern feminist theories. While some authors use different concepts for post-structuralism and postmodernism, Tisdell uses the terms interchangeably. According to Tisdell, there are several main differences between structural and post-structural theories. First, structuralist feminists do not consider individual capacities for action, or the individual power and control women have over their own lives even when they experience structural oppression. Second, structuralists do not consider that some groups are more privileged than others. For example, Marxist feminism does not consider that White women have more privilege than women of color. In contrast, post-structuralist and postmodern theorists consider diverse systems of privilege and oppression including gender, race, class, and sexual orientation. In addition, these theorists take into account individual capacity for agency. While some forms of multicultural feminist theories are considered socialist feminisms, Tisdell prefers to classify them as post-structural because they consider a variety of systems of privilege and oppression. In summary, post-structural or postmodern feminist theories attempt to examine the intersections of many forms of oppression and privilege that are dependent on cultural and social factors.

This brief overview shows that there are clearly many different perspectives within the broad umbrella of feminist theory. For this dissertation research I drew

primarily from critical postmodern feminist theories, which foreground systems of privilege and oppression that depend on social and cultural factors, and also emphasize individual women's capacities for agency.

Social Construction of Gender

A number of feminist theorists (Connell, 2000; West, 1984) have argued for the importance of gender construction and have emphasized the relational nature of processes of gender socialization. Anderson (2002) defined socialization as "a process wherein the norms and values of an existing value system are transferred from one generation to the next" (p. 32-33). West and Zimmerman's (1987) concept of "doing gender" involves a "complex of socially guided perceptual, interactional, and micropolitical activities that cast particular pursuits as expressions of masculine and feminine natures" (p. 168). They argue that "doing gender" is undertaken by women and men "whose competence as members of society hostage its production" (p. 168).

West and Zimmermann (1987) describe and analyze how women and men act according to a perceived natural, biological division, which is not natural at all, but rather is cultural and socially constructed. Anderson (2002) also describes how "gendered individuals negotiate culturally accepted expectations in such ways that they reproduce gender appropriate behavior associated with masculinity and femininity. As a result, the construction of gendered identities appears natural" (p. 33). The concept of negotiation emphasizes the active role of the person, while at the same time recognizing that these negotiations are structured by hierarchies of power that shape individual behavior.

In their work West and Zimmermann refer to Garfinkel's (1967) study of a boy who began presenting himself as a female in his late teens and later underwent surgery for sexual reassignment. The case illustrates that gender is not tied to biology; rather, gender is created through interaction. The case also shows the dilemmas that individuals who undergo a sex reassignment face. According to West and Zimmermann (1987) "doing gender" appears almost as a natural act that reproduces and legitimates gender categories. The concept includes social structure while also same emphasizing elements of individual action and social control. Since 1967, when Garfinkel's study was published, acceptable gendered behavior has changed for both women and men; therefore, "the concept of masculinity, in particular, is changing although there are pockets where the machismo male image still prevails" (Anderson, 2002, p. 34).

Some authors (Frehill, 1997; Sadker & Sadker, 1994) argue that engineering education "does gender" by reproducing and perpetuating masculine attitudes. Frehill (1997) suggests, for example, that certain women are excluded from engineering because on average women take fewer of the science and math courses required for admission, leaving engineering education and the profession overwhelmingly masculine. Similarly, feminist theorists (Goodman & Cunninghan, 2002; Romkey, 2007) have argued that women are socialized in ways that discourage them from pursuing engineering; social pressures and stereotypes may discourage girls to engage in science and engineering. Engineering is still seen by society as a profession not suitable for women.

Feminist Pedagogy: Revisiting Learning Theories

These various feminisms have developed theories about power relations and social structures that inform feminist pedagogy (Tisdell, 1995). Feminist pedagogy refers to "the interactive processes of teaching and learning, particularly in relation to what facilitates women's learning" (Tisdell, 2000, p. 155). Feminist pedagogy focuses on the educational needs of women and assumes that the traditional educational system is based on the needs of men from privileged race and class positions. Different versions of feminist pedagogies are concerned with increasing women's choices and status in the society, noting the importance of relationships, connections, and the role of affect in learning.

Dentitth and Brady (2001) use critical postmodern feminist *theory* to craft a critical postmodern feminist *pedagogy,* which recognizes the power of relationships that exist in the educational system, acknowledges differences, and works to create social change. The authors state that feminist theory can bring integrity to the practice of education, while postmodern theory can help emphasize diversity and acceptance. The authors outline six principles of a critical postmodern feminist pedagogy including: (1) the recognition and valuing of students' experiences as central to teaching and learning, (2) the need to develop safe spaces for student's voices, (3) the need to understand power and agency, (4) the recognition of differences, (5) the development of a language of critique and possibility, and (6) the evolution of teachers as intellectuals. These pedagogies help teachers and learners recognize systems of power present in colleges of engineering in Mexico; help teachers and learners acknowledge differences

in classrooms; and facilitate teachers and learners in the process of becoming active agents and developing the capacity to bring about social change.

Although theories about women as learners have changed over time and have been reinforced by the success of women in formal education, the nature of women's learning remains controversial. Flannery and Hayes's (2000) review of the literature on women's learning reveals that descriptions of women's learning often reinforce stereotypes that question the capabilities of women. She also found that many of these theories overgeneralize the differences between women and men. Hayes (2001) describes how popular beliefs about women as learners—such as the significance of relationships, connections in women learning, and women's presumed preferences for subjective and affective ways of learning—remain questionable. Gilligan (1982) and Miller (1986) popularized the idea that women see themselves, and their worlds, mainly in relationship to others. The centrality of *relationship* has led to the recommendation that educational programs for women should emphasize collaboration, support, and affiliation. In addition, Belenky et al. (1997) assumed that connected learning was preferred by the majority of the women in their study. Consequently they proposed "connected teaching" (p. 214) to support this way of knowing. They argued that educators could help women develop their voices if they stressed connection over separation, understanding and acceptance over assessment, and collaboration over debate. Hayes (2001) argues that this orientation toward relationships and connected learning has led to beliefs such as that women learn better in groups than alone. This

orientation toward relationships, however, can "fuel stereotypes that women are not, or cannot be competitive or self directed" (p. 37).

Women experience considerable social pressure to conform to gendered norms and react in a variety of ways, either complying or rejecting conformity. Hayes (2001) cites an example:

> …if a social norm dictates that "self-assertiveness" is inappropriate for women, one female student might choose to be quiet or self-deprecating in order to maintain her "feminine" identity, though these behaviors might raise questions about her academic ability. Other women might choose to be more assertive, risking negative judgments about her femininity in favor of expressing her knowledge and confidence. In each case, gender affects both behavior and its outcomes (p. 39).

This view of gender suggests that the learning characteristics of women are not fixed or innate in all situations, but, rather, they are connected to particular situations or social or historical circumstances. These gendered belief systems can contribute to women's approaches to learning. Critical postmodern feminist theories see relations of power within their economical, historical and social contexts and recognize the unfairness of many gendered social practices. In addition, these theories contribute to the ability of students to understand and change both themselves and society (Dentitth & Brady, 2001).

Summary

In this chapter I presented the special characteristics and particular history of higher education in Mexico. This discussion revealed that although higher education in Mexico was founded with the purpose of reaching social equality, it has not been able to achieve this goal not only because of the low level of youth participation, but also because of the low level of female participation in male dominated fields such as engineering. In addition, I reviewed the literature on Mexican women's participation in higher education, which has increased substantially in the last three decades and has reached 50%. However, female participation in Mexican engineering program is still low.

Next, I reviewed three bodies of literature to offer a framework to interpret and understand why female engineering students in Mexico stay in such a male dominated field. I began by examining empirical research on college student retention. This section revealed that there are individual and institutional characteristics that have been shown to impact college student retention. Next, I presented literature on recruitment and retention of female students in engineering. This section revealed a gap in the literature regarding Mexican women who succeed in engineering colleges.

Finally, I summarized various feminist theories to introduce my theoretical framework, which lies specifically in critical postmodern feminist theory. One issue discussed within critical postmodern feminism is the social construction of gender, which I am using to frame how gendered socialization is an issue for women participation in engineering education. Specifically, this literature suggests that the

power of a masculine culture influences colleges of engineering in ways that tend to reproduce male power and privilege. Critical postmodern feminist pedagogies help us understand power relationships present in engineering colleges and encourage students to become agents in the social change. Finally, I discussed how traditional learning theories might stereotype women as unable to be competitive or self-directed.

CHAPTER III

METHODOLOGY

The purpose of this study was to explore the experiences of female students in engineering programs in Mexico, and to understand why they remain in their programs. The methodology used in this study was exploratory and descriptive with the intent to identify and describe the experiences of female engineering students in Mexico and the sources of support and strategies that helped them persist in their programs. To address this concern, I used qualitative methods of inquiry.

Qualitative Methodology

Creswell (2002) argues that the selection of the method of research is closely tied to the identification of a research question and the purpose of the study. The research questions and purpose of this study were mainly exploratory and descriptive. Merriam (1998) states that researchers who conduct qualitative studies "… seek to discover and understand a phenomenon, a process, or the perspectives and worldviews of the people involved" (p. 11). The focus of this research was to understand the perspectives and perceptions of female students in engineering colleges in Mexico regarding their decision to stay in college and continue with their engineering program.

An initial generic definition of qualitative research is given by Denzin and Lincoln (2005) as "…a situated activity that locates the observer in the world" (p. 3).

The term "qualitative research," carries complex interconnected concepts and assumptions, and many different methods and approaches fall under this broad umbrella, including case study, participatory inquiry, interviewing, participant observation, visual methods, and interpretive analysis (Denzin & Lincoln, 2005). Qualitative research helps us understand and explain the meanings of social phenomena; its philosophical assumptions are based in the view that reality is constructed by individuals interacting within their social worlds (Merriam, 1998). Patton (1985) explains that qualitative research seeks to understand situations as part of a particular context—it seems to understand "… what it means for participants to be in that setting, what their lives are alike, …what their meanings are" (p. 1). Qualitative research offered the most appropriate approach for this study because in this project I sought to understand the particular experiences of female students in engineering colleges in Mexico, from their points of view.

Merriam (1998) describes five characteristics of qualitative research: (1) it is interested in understanding meaning that participants have constructed, (2) the researcher is the main instrument for data collection and analysis, (3) it usually requires field work, (4) the research is inductive, meaning that it builds concepts or theories rather than tests theories, and (5) the product of qualitative research is richly descriptive because of its focus on meaning and understanding.

These five characteristics guided my study. I sought to understand the perceptions of women students in engineering colleges in Mexico. I visited engineering colleges in Mexico where I conducted the observations and interviewed participants,

who shared their experiences as students. The study was mainly exploratory aiming to understand the phenomena rather than testing an existing theory. And finally, the results of this study focused on the description and understanding of the students' experiences and how these experiences helped them remain in their engineering programs.

Research Design

Research design, according to Bogdan and Biklen (1998) refers to the plan a researcher has in how to proceed. For this research, I chose a generic or basic qualitative research with a constant comparative method of data analysis. This study used an exploratory qualitative inquiry approach. Exploratory data analysis has been described as a "method for discovering unforeseen or unexpected patterns in the data and consequently [for] gaining new insights and understanding of natural phenomena" (Gall, Borg & Gall, 1996, p. 197).

I begin this section by briefly describing a generic or basic qualitative research design. I then provide descriptions of the participants and institutions, data collection, and data analysis. I continue describing the techniques used to establish validity and trustworthiness. Finally, because the research was done in an international setting, I include a short discussion on culture and translation for cross-cultural research (González y González & Lincoln, 2006).

Basic or Generic Qualitative Study

I was interested in how the experiences of female students in engineering colleges in Mexico impacted their decision to remain in their programs, and how female

engineering students understood their experiences in college. To better understand participants' perceptions, I used a generic qualitative approach using qualitative data collection techniques such as interviews and observations.

Merriam (1998) states that "basic" or "generic" qualitative studies simply seek to understand a phenomenon and the views of the people involved. As with other forms of qualitative research, the investigator is the primary source for gathering information, as she takes an inductive position and attempts to derive meaning from the data. In generic or basic qualitative studies, data are typically collected through interviews, observations, and documents. For analysis, basic qualitative research often uses the constant comparative method initially proposed by Strauss and Corbin (1998) and further explicated by Creswell (2002; 2006), which consists of comparing segments or units of data to determine similarities and differences. The analysis usually identifies recurring patterns among the data and groups these patterns into categories. These categories are then arranged in relationship to each other and the researcher seeks to identify a central phenomenon connecting these categories. Findings are usually a mix of description and analysis, resulting in the identification of patterns, and an understanding of the context. In the last step of the analysis, the investigator explores conditions, strategies and the context for that central phenomenon, and writes a "story line" to connect these categories (Creswell, 2006). Generic qualitative research, like other qualitative research, has an emergent design, meaning that the design of these studies is not fully established before the study begins, but emerges as data are collected and analyzed, and the context is described. The questions, the form of data collection, the individual studied, and the

sites may change in order to learn more about the phenomenon from the participants, to better address the research questions, or to gather richer data (Creswell, 2006). Finally, according to Merriam (1998), the analysis in basic or generic qualitative research does not necessarily build theory.

Descriptions of Participants and Institutions

Participants for this study were all female engineering students enrolled in colleges of engineering in Mexico. The students selected for this study were at least in their third year of college, which I used as evidence that they had decided to stay in their programs. The colleges selected were part of the National Association of Engineering Colleges (*ANFEI, Asociación Nacional de Facultades y Escuelas de Ingeniería*), and the National Association of Universities and Higher Education Institutions *(ANUIES, Asociación Nacional de Universidades e Instituciones de Educación Superior*).

ANFEI is an organization with the purpose of grouping and strengthening colleges of engineering throughout Mexico (ANFEI, 2003). ANUIES is a non-government association that includes 145 higher education institutions and nearly 80% of the Mexican higher education population. It is the most widely recognized higher education association in the country.

In qualitative inquiry, the intent is to develop an in-depth exploration of a central phenomenon, not to generalize the findings to a population (Creswell, 2002). Thus, I purposefully selected individuals and sites that could help me understand the experiences of female students in engineering colleges in Mexico. One characteristic of qualitative research, according to Creswell (2002), is that it presents multiple perspectives of

individuals to represent the complexity of the situation under investigation. I interviewed 20 participants from 2 private and 2 public universities and from different engineering programs. I chose the sample based on the contexts, expecting that a diverse sample would provide rich information. I selected the institutions based on diversity: public and private universities, engineering programs offered, geographic location, size, socioeconomic level, and accessibility to the researcher. This last factor was determined by engineering professors and administrators that I knew in those institutions and the responses of the individuals I contacted.

Participants. Participants in this study were all young adult women with an average age of 21 years; 17 of them lived at home with their families. Students' family education was very diverse; most of the fathers were college educated and half of them were engineers. About half of the mothers had attended college, although not all of them had completed their studies; only one mother was an engineer. Some parents were currently in college pursuing bachelor's or master's degrees, or various types of certifications. However, some students were first generation college students.

Ten participants were attending private universities, while the other ten were students in public universities. I also addressed two different types of engineering programs. The first type, which I called Type I, had at least 25% female participation at any given school. These programs included computer science and industrial engineering. The second type, which I call Type II, had less than 10% female participation. These programs included mechanical and civil engineering. Thirteen students were in their last

year while seven were at least in their third year. Table 1 illustrates participants' enrollment in public and private universities and the type of programs.

Table 1—Number of Participants by Type of Engineering Program and Institution

	Type 1 (more than 25% of women in the program)	Type 1 (more than 25% of women in the program
Public	5	5
Private	6	4

While it varies slightly by school, most universities in Mexico require four and a half to five years of study to obtain an engineering degree. Some universities also require engineering students to write a thesis to obtain their undergraduate degree. Nearly half of participants were in this final stage of writing their thesis. Although none of them had yet graduated, they all saw themselves as graduating soon.

Institutions. Data from students were gathered from four different universities in Mexico. Current data on student demographics were not available from all universities. In constructing the demographic profiles presented below, then, I used demographic data provided to me by some of the universities, and supplemented this information with public data I found on the Internet. Additionally, I located a comparative report on student demographics by engineering program and gender, available through ANUIES. However, the most recent version of this report was published in 2000 (ANUIES, 2000). I used this report only when no other source of information was available. The names of the universities used in the following section are pseudonyms.

The first university is Mexican University which is the largest university in the country. It has campuses throughout the country and even some campuses outside

Mexico. Its enrollment is nearly 300,000 students, including college and graduate students as well as some high school students. According to its mission, this university includes students from all socioeconomic backgrounds. Its origins can be traced to the Colonial Period, as it was founded in 1551. The university is very prestigious and includes three Mexican Nobel prize winners as part of its alumnae. The campus where I interviewed is located in Mexico City and is the largest campus of the system. It was founded in 1952 and displays murals from famous Mexican painters such as Diego Rivera and David Alfaro Siqueiros.

This public university is widely recognized for its engineering programs, which date back to the Colonial Period when mining was considered an important activity and economic mainstay. The first school of mining is considered the ancestor of the College of Engineering of this university (UNAM, nda). At the time of this study, the college of engineering had a population of 10,500 students, with 1750 (17%) women (UNAM, 2006). The college offered twelve different engineering programs at the time of the study. Engineering classes in this university take place in two different settings. The first is called "*El Anexo*" ("The Annex"), is where most of the first year courses are taken, and is located far away from the main engineering campus, which is called "*La Facultad*" ("The Faculty"). Students attending classes at *La Facultad* have been able to finish basic courses and persist in their programs. According to participants in this study, students see it as a privilege to take classes in the buildings of *La Facultad;* the higher status of classes in *La Facultad* is reflected in the buildings' infrastructures and locations. The buildings from *La Facultad* are more appealing and located on the main

campus while buildings in *El Anexo* are far away from the main campus and less alluring.

The second university is State University and it is located in south-central Mexico. In Mexico, every state has only one state-supported university; this university is in one of the smallest states in Mexico. The university receives both state and federal funds. State University started as a Higher Education Institute with careers such as nursing, law, odontology, and business. In 1976 it was established as the State's university. Two years later the engineering college was created and now it offers six different programs. Students from this university are middle-low to low socio economic class and come from surrounding states. Most students use public transportation and only a few have cars. The university's main campus is located at the city capital and the engineering college is in a city about 20 minutes from there. In the college of engineering, all of the buildings are one story and are distributed on a large piece of land, with small sports fields scattered across the campus. The library is small and uses an antiquated system for book and journal requests: everything is written by hand and there are no electronic backups or processes. When I conducted the study, State University student population was 8,650, which included 950 or 11% engineering students. Of the 950 engineering students, 370 (39%) were female (Ortiz, 2007). However, these figures overinflate the numbers of females in engineering because at State University chemistry and mathematics are part of the engineering college. These two majors have nearly 60% of the female students in that college, and are not considered part of engineering colleges at the other universities in this study.

International University is a private institution that is very well known both in the state where it resides and throughout Mexico. It is located in Southern Mexico in the state's capital in an ancient *hacienda*. It was originally founded as a college in Mexico City in 1940, with resources from the United States, and is currently a member of the Southern Association of Colleges and Schools (SACS) in the U.S. At the time of the study, the student population was about 7,800, which includes 2112 or 27% engineering students. The female population in engineering is 420 or 20% (UDLA, 2006). The college of engineering at International University offers eleven different degrees in engineering. The students from this university are considered high-middle socioeconomic class.

Finally, Catholic University is a private Catholic higher education institution with three campuses throughout the country. The campus where I conducted interviews is considered the main campus and is located in Mexico City, in an ancient colonial *hacienda*. The institution's facilities are in perfect condition, including perfect green spaces and preserved colonial buildings. This institution started in 1967 as a graduate business school. The student population at the time of the study was nearly 3,500. The engineering student population was 700 (20%) which includes 147 (21%) female students. This university offers three engineering programs: mechanical, industrial and computer science, which are recognized among the best in the country. Most of the students attending this university are high-middle socioeconomic class.

Data Collection

For this qualitative study, the researcher was the primary data-gathering instrument, in accordance with a constructivist paradigm. Lincoln and Guba (1985) explain, for instance that "the researcher, by necessity, engages in a dialectic and responsive process with the subjects under study" (Lincoln & Guba, 1985, p. 44-45). I collected data for this study primarily from interviewing students individually, and secondarily by conducting observations in selected universities. In addition, I reviewed institutional documents describing the background of the students, enrollment, and attrition rates.

Interviews. In qualitative research, interviewing is often the most important source of data needed for understanding the phenomenon (Merriam, 1998). Interviews help researchers "understand and put into a larger context the interpersonal, social, and cultural aspects of the environment" (Erlandson, Harris, Skipper & Allen, 1993, p. 85). Patton (1985) explains that by interviewing people, researchers find out what they cannot directly observe, like feelings, thoughts and intentions. In addition, researchers can enter into the participant's perspective.

Interviews may take a wide variety of forms. The most common form of interview is person-to-person; however group interviews or focus groups can also be used to collect data. Merriam (1998) explains that the amount of structure desired is the most common way to decide the type of interview to be used. The types of interviews range from highly structured to unstructured open-ended formats. In a highly structured interview, the questions and their order are determined ahead of time, and all participants

receive the same questions. Semi-structured interviews are guided by a list of questions to be explored, allowing the researchers to respond to the situation and the respondents to add new ideas. Finally, open-ended interviews are unstructured and informal with few pre-determined questions. This type of interviews is mainly exploratory.

For this study, I conducted semi-structured interviews guided by a set of questions and issues to be explored. This format allowed me to be flexible and to explore issues that arose that I might not have considered before the interviews. I was also able to expand and revise the interview guide as the research progressed. In order to contact the students to complete the interviews, I sent invitation letters via e-mail to the deans of the colleges selected for the study. The letters were written in Spanish, explained the purpose of the research, and asked for cooperation in this study. A Spanish example of the letter and its translation to English is presented in Appendix A. Next, I contacted by telephone those deans who accepted the invitation, and asked them to help me contact participants for the study. With information from the deans' offices, I contacted the first four students by e-mail or telephone and set a date for the interviews. I interviewed these four students, two from State University and two from International University, via the computer program "Skype," which uses Voice over Internet Protocol (VoIP) technology. Skype allowed me to both hear and see participants, and to have a conversation with them through the computer, using the Internet and a web camera. I asked each participant slightly different questions in order to frame general questions for the final version of the interview guide. I tape recorded these interviews, and transcribed and reviewed them in order to analyze my research progress up to that point. After these

interviews were analyzed, I worked on a final version of the semi-structured interview guide, which is presented in English and Spanish in Appendix B.

With the final interview guide completed, I planned a first trip to Mexico where I visited two universities (Mexican University and International University). With the help of the various deans I was able to contact some students and schedule interviews before leaving for the trip. After completing the pre-scheduled interviews, I asked participants to suggest more respondents. I interviewed eleven students during this trip. In a second trip to Mexico two months later I visited Catholic University and interviewed four students. Finally, I conducted the last interview through Skype when I returned to Texas.

I conducted a total of 20 interviews. Each interview lasted between one and one-and-a-half hours. The interviews were tape-recorded and transcribed as soon as possible on an on-going basis. Before the beginning of the interviews, all participants were presented with the appropriate IRB forms, in this case information sheets (the Spanish version and its translation to English are shown in Appendix C) that explained the purpose of the study and invited them to participate. In all cases, I asked permission to audio-tape the interviews. All interviews were conducted in Spanish. Confidentiality is important to assure that information is freely given. To assure confidentiality, the information sheet I gave to each participant is not linked in any way to her identity. In addition, I asked each participant to provide a pseudonym for their identification, and I omitted details that could identify any of the participants.

During the interviews, participants shared thoughts, beliefs, and experiences of being a woman in an engineering college in Mexico, and explored how they were able to

"survive" in this male-oriented environment. In addition to these questions, I also collected demographic information from participants, including but not limited to age, engineering program being pursued, GPA, class year (freshman, sophomore, etc.), years of school their siblings had completed, and the educational backgrounds of their parents. These data were an important analytic source to understand the context of each participant and her responses.

In qualitative research, according to Creswell (2006), researchers are influenced by their background, history, and contexts as they make interpretations of the data they collect. Peshkin (1988) argues that researchers should recognize their subjectivity while the research is in process, in order to be aware of how their subjectivity can shape their inquiry and its outcomes. Like many qualitative researchers, I approached this study with attachment. While conducting this study I was not and did not pretend to be a neutral researcher. I came to the interviews with my own beliefs and experiences about being a woman in engineering. I started the interviews by informing participants that I am an engineer who has worked in engineering colleges in Mexico as faculty and as an administrator, and that I was a Ph.D. student in Texas interested in the retention of female students in engineering colleges. I introduced the study to the participants and shared comments about being a female in a male-oriented environment. I also discussed with them the perceived changes in engineering college environment that have occurred over the last twenty five years. I then asked questions about their experiences as students; the role played in their retention by their families, their institutions, their peers, and their professors; and a variety of questions about their feelings in the engineering

environment. I sometimes shared my personal experiences to encourage participants to add or to clarify their responses. Sharing my own experiences as an engineering student allowed participants to feel more comfortable and for us to build rapport. I followed up with many participants for further clarification of their data via e-mail or telephone.

Observations. I used observations as the second source of data for this study. Observations, according to Merriam (1998), take place in the natural setting of participants, allow the researcher to have a firsthand encounter with the phenomenon studied, and can provide some knowledge of the study context. There are different types of observations with regard to the relationship between the observer and the observed that range from the observer being a complete participant to a complete observer. I conducted observations of the sites and the participants when I visited the universities for the interviews. Although I planned to be simply an observer in the engineering classrooms and to write notes during the observation sessions, I found that many participants were in their last year of college and were thus writing their thesis and not taking classes. This situation led me to observe last-year students working on their thesis and interacting with their peers and professors mainly in the labs, and to attend two third-year classes to observe classroom environments. I kept field notes throughout each visit, noting peer-to-peer and peer-faculty interactions, including verbal and non-verbal language; descriptions of the classrooms, and the buildings.

When I visited Mexican University, I was able to observe the engineering environment at *"La Facultad.*" I was impressed by the number of students in the college and the energy present in the buildings. The buildings were full of people all the time

moving from one place to another, there were also many posters that ranged from academic information like invitation to conferences, meetings, and courses to advertisements about commercial, political and social issues. Contrasting colors were everywhere. The library was like a collage consisting of people, books, magazines, newspapers, colors, academic ambience, and ideas. In addition, I was assigned to a lab where I was able to observe how students work on their theses and how they interact with each other and with professors. Furthermore, I walked with one of the students to the library and went with her to visit her advisor.

In addition, to observing the last-year students at International University, I was assigned a place in the lab where all students were working on their theses. Most of the students working in the lab while I was observing were female, and they soon found out I had studied in France and that I knew one of their professors. I quickly became an "opinion giver" rather than solely an observer, as students began to read parts of their theses to me and ask for my opinion. They also asked me about my student life in France and how it was to be a woman in an engineering masters program in Europe. By building an environment of trust and confidence, I was able to interview the female engineering students in the lab one by one, and to observe their peer relationships, for a full two days. Furthermore, these students referred their friends from different engineering programs for possible interviews.

Finally, I observed two classes conducted in the private universities that were taught at a junior level. The first class was a mechanical engineering class with two female students at International University, and the second class was an industrial

engineering class at Catholic University. In the Catholic University class nearly 25% of the students were females. All observations provided additional information of the social interactions that occur during day-to-day activities in the colleges.

Review of the Documents. In addition, I reviewed documents from each institution. Jarvis (1987) argues that researchers who have the opportunity to use documents can better understand the situation where practice takes place. Not all universities in my study allowed me to review their documents; however, in some cases these documents were available on-line. I reviewed demographic institutional reports such as enrollment, attrition, professor-student rates, and other documents containing information such as university history, rewards, recognitions, and future visions. These data were important sources to understand the context of each participant.

Data Analysis

In qualitative research, data analysis does not only occur after the data has been gathered, but throughout the process of data collection. According to Merriam (1998), "simultaneous data collection and analysis occurs both in and out the field" (p. 162). I analyzed data using the constant comparative method developed initially by Glasser and Strauss (1967) and further explicated by Strauss and Corbin 1998) and Creswell (2002). This method involves three processes or steps. The first step, open coding, consists of taking the data--in this case the interview transcripts—and "segmenting" them into categories of information. In this process the researcher starts by identifying data units, defined by Merriam (1998) as "any meaningful or (potential meaningful) segment of data" (p. 179) and assigning codes to these units, and then grouping these units by code,

which begins the process of category formation. These categories are abstractions derived from the data which not only describe the data but also interpret the data (Merriam, 1998). For my study, after transcribing the data and reading each interview many times, I identified meaningful units of data, giving each unit a code which illuminated the meaning of the data unit. My initial categories were formed based on the type of student experiences such as personal feelings; relationships with peers, professors, and institutions; perceptions of culture; and family.

The second step in the constant comparative method is called axial coding. In this step the researcher identifies a central phenomenon and then relates categories from the open coding step to their subcategories to form more precise explanations of the phenomena. The term "axial" is used because coding occurs around the axis of a category (Strauss & Corbin, 1998). To relate the categories, the researcher needs to explore casual conditions, specific strategies, and contexts that delineate the phenomenon (Creswell, 2006). For my study, I identified dimensions that described different relationships among the open coding categories. For example, for the category "relationships with peers," I identified different dimensions such as positive, negative, patronizing, patriarchal, and supportive.

The final step of coding is called selective coding, and consists of interrelating categories, or the process of integrating and refining categories at a higher level of abstraction (Creswell, 2002). The researcher takes the central phenomenon and systematically relates other categories, validating their relationships. Creswell (2006) refers to this step as the development of a "story" that narrates categories and shows

their relationships. A deeper level of analysis, the final process can include making inferences, developing models, or even generating theory. I recognized broader themes that helped me identify the main findings of my study as well as some conclusions. These themes centered upon female students' experiences in the colleges of engineering, how the masculine Mexican culture permeate the colleges, and how students' sources of personal support helped them stay in their programs. A last theme that emerged was the sense of pride the female students shared for being able "to survive" in their programs.

Validity/Trustworthiness

Merriam (1998) states that "research is concerned with producing valid and reliable knowledge in an ethical manner," (p. 198) and validity and reliability can be approached through careful attention to conceptualization, data procedures, and findings presentation. For this study I used triangulation, peer debriefing, and member checks as techniques to establish validity, as I describe below.

Triangulation

Triangulation leads to credibility by using different sources. Different techniques are used in qualitative research for establishing validity. For my study, to ensure credibility, I used different methods to collect data for this study: interviews, observations, and documents. Interviews constituted the main source of data collection for my study and allowed me to direct the questioning. In addition, referring to Lincoln and Guba (1985), persistent observation adds salience to a study; it helps the researcher to identify relevancies and atypical cases. I observed students in their institutional

settings such as the two labs where the students worked in their theses and also observed two engineering classes. Finally, I reviewed documents at each institution that helped me understand the experiences of the female students in engineering colleges.

Peer Debriefing

I used peer debriefing to provide an external check of the inquiry process, to discover my own biases, clarify my interpretations, and discuss possible future directions. Lincoln and Guba describe a peer debriefer as "someone who is in every sense the inquirer's peer, someone who knows a great deal about both the substantive area of the inquiry and the methodological issues" (1985, p. 308). I selected a professor who recently obtained her Ph.D. She has 20 years of experience in a Mexican public university as a professor and as an administrator, which have given her a clear vision of the Mexican public higher education system. Although she is not an engineer, she has taught engineering students in the subjects of Management Systems and English as a Second Language. She is involved in a group in an engineering school to provide support for women in engineering and has researched cultural aspects in education. She is familiar with qualitative methodology and her remarks and observations were very helpful.

My second debriefer is also a professor in Mexico. He is the dean of the engineering college for Catholic University and has been an advocate for and supporter of women in engineering throughout his professional life. My classmate and life long friend, he gave me not only great conversations accompanied by good lunches, but also great insights about the engineering environment, the students, and the professors. In

both cases most debriefing sessions involved conversations, discussions, and question and answer periods.

Member Checks

Finally, I gave respondents the opportunity to review the data gathered and accept or modify the information. This member checking technique is described by Lincoln and Guba (1985) as the most important in establishing credibility. After each interview was transcribed into a word document file, I sent the file to participants through e-mail and asked them to review the documents. Fifteen students replied to the e-mails confirming receipt of their data, and some students modified their responses. These changes were transcribed and were included in the original data. In addition, while I was analyzing the data, I contacted four of the students, three through e-mail and one by telephone, and asked them to clarify their responses. All of these students responded, and the information was included in the original data.

Working Bilingual Data: A Note on Cross-cultural Research

This research studied the experiences of female engineering students in Mexico. The results of this research are addressed to two different audiences, the English speaking academic community and the Mexican Spanish-speaking college community from which the data were collected. González y González and Lincoln (2006) suggest that the researcher should provide both audiences with an understanding of the data. They explain that research conducted in different languages, contexts, and cultures needs to include the understanding of at least five major ideas: (1) working with bilingual data,

(2) considering non-Western cultural tradition, (3) multiple perspectives, (4) multivocal and multilingual texts, and (5) technical issues to ensure accessibility.

One of the most important challenges in conducting cross-cultural studies is the accuracy of translations. González y González and Lincoln explain how the "translation of the language includes the translation of the contexts and cultures" (2006, p.194). Translations can result in meanings that are not parallel (equivalent) in the two languages and cultures. As a result, some authors (Anzaldúa, 1987; González & González, 2004) suggest presenting the data in both languages.

Given the importance that context plays in understanding a culture and the role that language plays in context, data for this research was collected in Spanish and was kept in Spanish for the coding and categorizing. My decision to write a bilingual dissertation was based on the idea that preserving the original language would keep the richness of the data, and the Spanish-speaker reader could easily understand the exact meaning of each unit. Participants frequently used colloquial language, which gives the reader a sense of their youth, culture, and feelings; this sense would be lost if I had only presented the data in English. As a researcher in a bicultural study, I present the finding of my study with quotes from participants in English and Spanish. The original Spanish version is written in italics.

In this chapter, I presented a brief description of qualitative methodology, and, more specifically, a generic or basic qualitative research design, which was the approach used for this study. I then described the students and institutions that participated in the study, and explained data collection, which included interviews, observations, and

reviews of documents. I provided a description of the data analysis process and the procedures I followed to ensure validity and trustworthiness. Finally, I included a note on cross cultural research because this research was done in an international setting. Findings are further discussed in Chapter IV. In Chapter V, I present the conclusions and recommendations for research and practice.

CHAPTER IV

RESEARCH FINDINGS

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FIGURE 4. Engineering ratio.

"Are you an engineer? But you are not that ugly mija,… you are very pretty"

[¿Eres ingeniera?, pero si no estas tan fea mija…. Estás muy bonita]

Traveling from Houston to Mexico City to attend a conference on women in engineering, I sat on the plane near a 90 year-old man who was retuning to Mexico City after having surgery. When I told him I was attending a conference at UNAM's College of Engineering, he told me he was an alumnus, and his immediate expression was "Are you an engineer? But you are not that ugly mija… you are very pretty" [*¿Eres ingeniera? pero si no estas tan fea mija…Estás muy bonita*]. He told me that when he was a student the few female students attending the college were not pretty, "but …they were very bright" [*pero eso si eran muy listas*…], he continued.

Gender-based stereotypes are present both in popular culture and within educational systems. For instance, engineering is often portrayed in popular culture as "geeky" and particularly inappropriate for girls and women (Muller, 2003). Negative stereotypes infuse popular discourse, proclaiming that women lack math ability, and that "real girls" should not be good at math and science (Loshbaugh & Claar, 2007, Muller, 2003). Educational research literature has shown that such gender-based stereotypes abound within educational systems, as well, and have negative impacts on girls (Figure 4); additionally, this literature has shown that women are less likely than men to choose an engineering major, partly because of these negative stereotypes (Frehill, Ketchman, Jeser-Cannavale, 2004). These stereotypes are especially strong in Mexican society, where female students in engineering are often stereotyped as being the least appealing of women in any other college program.

Having the opportunity to study education after 15 years of teaching in engineering colleges in Mexico allowed me to re-consider the values that have guided my teaching life. I have always been convinced that education is the great equalizer of human lives. Education has proven to contest unequal opportunities, however in some cases it has also contributed to the reproduction of social inequalities based on class, race and gender. While analyzing the context where education—and, more precisely, *learnin*g—takes place, i.e., culture, institutions, and social and historical conditions, questions are raised about whose interests are been served, who has access to these programs, who holds the power to make changes, and how learning opportunities are

structured (Cervero & Wilson, 1994, 2001; hooks, 1994; Merriam & Caffarella, 1999; Sandlin & Cervero, 2003).

Introduction

The purpose of this study was to explore the experiences of female students enrolled in engineering colleges in Mexico, and to understand why they remain in their programs. This study employed a qualitative research design, focusing on interviews with female students in engineering colleges who persisted as the main source of data. The participants of this study were all in their last two years of college and described themselves as "graduating soon." During the interviews, these students shared insights about their student life experiences, their perceived abilities that helped them stay in their chosen engineering programs, their sources of support, and the strategies they used to deal with the difficulties of being students in male-oriented engineering environments.

Findings focus on how female students created or found sources of support that helped them stay in their programs. Participants described their experiences in college as very challenging and perceived the environment as hostile and uncertain. In addition, patriarchal Mexican cultural values and stereotypes were identified by students as influencing and helping shape the engineering environment. However, in this context, participants were able to find sources of support and use strategies that helped them remain in their majors, such as a strong desire to succeed, a perceived academic self-ability; and support from their families, peers, institutions, and—most importantly—their professors. Finally, the fact that participants were able to persist in their programs

gave them a sense of pride and satisfaction that was shared by their families, peers, and faculty.

To present the findings, I start by describing the context in which this study took place, which includes participants' perceptions of Mexican culture, and of the college of engineering environment. Next I describe the role of faculty, peers, and institutions in participants' retention. Finally, I explain the motivation for success and the pride participants experienced as a result of being able to finish their programs.

Mexican Culture

In this section I present the context in which women study in engineering colleges in Mexico. I start by describing the inequalities in the education of females and males in Mexico and how these inequalities can be traced through Mexican history. Then I present the different manifestations of the Mexican culture described by the participants, and finally how these manifestations permeate and influence the engineering colleges in Mexico.

The engineering environment is situated in a patriarchal Mexican culture that has a strong influence on the student experiences of the participants in this study. The masculine culture so prevalent in Mexico has manifested in inequalities in the education of males and females throughout history. This situation can be traced to indigenous cultures; ancient Aztec and Mayan texts describe how girls needed to learn house work from an early age, and how their education consisted of family values and obedience as feminine characteristics. In contrast, boys studied religion and government subjects that

led them to gain occupation and prestige within their society (Muriel, cited in Montero Moguel & Esquivel Alcocer, 2002).

During the Spanish colonial period, 1575-1810, education in Mexico (New Spain at the time) was based on religion, giving the Catholic Church great political and economic power. The Spanish government had an unequal social structure based on uneven wealth distribution, work or profession, and race. Spanish women were in charge of Native and Spanish girls' education encouraging one religion: Catholicism, and one language: Spanish. Reading and writing at the time were not considered appropriate for women. Few schools taught women to read and write and this privilege was given only to Spanish girls from high socio economic classes. By the end of this period, new ideologies from Europe brought the notion that all women needed to be educated (Gonzalbo Aizpuru, 1998).

In the nineteen century, during the first years of Mexico as an independent country, some schools for women were created; these included elementary and vocational schools that gave women access to paid work. In addition, new ideologies of education permeated Mexican society, creating new schools for women like the *Escuela Secundaria para Personas del Sexo Femenino,* [High School for Female Students]. The curricula of this school included history, basic writing and math, and subjects like women's duties in society, mothers' duties in families, home economics, and manual arts. Vocational subjects were directed towards jobs that were "suitable" for women at the time, such as teaching and gardening. Consequently, even though higher education was not forbidden for women, women did not have enough preparation to gain access

(Montero Moguel & Esquivel Alcocer 2002). Thus, only two women graduated from higher education during the nineteen century in Mexico. In contrast, the *Escuela Nacional Preparatoria* [National Preparatory School], which was only for men, taught advanced math and calculus, geography, chemistry, philosophy and Spanish. By the beginning of the twentieth century, in 1907, the first women graduated from this high school, and enrolled in higher education at the National University.

García Guevara (2002b) states that in the twentieth century, education in Mexico continued to be influenced by social and political forces that segregated women. For example, historically the Mexican government encouraged women to be teachers, a profession that continues to be plagued with low salaries. In addition, popular media and religion also facilitated "stereotypical" gender roles by encouraging women to enter so-called "acceptable" occupations such as teaching and to fulfill their "domestic responsibilities." Media and religion also made it clear to women that their primary responsibilities included procreation, denying themselves, and being humble (García Guevara, 2002b). Since these inequalities can be traced through Mexican history, today in Mexico this division is often masked as cultural expectations; stereotypes concerning the roles of women still abound.

In this section I describe various manifestations of Mexico's masculine culture, as described by participants. First, participants described how Mexican society's gender roles have permeated their families and the job market. These roles differ substantially from their own idea of gender roles, and although participants expressed their desire to challenge these traditional roles through higher education, they struggled as they

negotiated their way through gender stereotypes. Next, I describe the cultural stereotypes that created extra stress for female students in engineering colleges. These stereotypes include women's lack of ability in math and science, perceptions of women as unsocial "nerds," as unfeminine, and as the least attractive students of the institutions. Participants in this study were keenly aware of the masculine culture that affects colleges of engineering; however, despite that knowledge, they decided to enroll in engineering school, challenging and resisting traditional gender roles in Mexican society.

Gender Roles

The masculine culture that dominates Mexican society became visible to participants in different ways and has contributed to a culture of gender discrimination in colleges of engineering. Participants identified gender roles as a manifestation of this culture, and discussed how their own perceptions of gender roles differ substantially from society's. All of the participants in this study expect more equity and view themselves as professional engineers.

Participants described their perception of how Mexican society has conceptualized the role of women in society. They were aware of the stereotypes of gender roles and described how common it is for Mexican society to expect women to take care of the house and for men to work outside of the home; they described the roles assigned to women as mothers, care-givers and mainly responsible for children. For instance, Gaby stated,

> …there is still a lot of machismo. If someone's a man, he's supposed to go to work and the woman is supposed to be at home. We are accustomed to women doing everything, being the one who takes care of us, understands us—it's a tendency of Mexican society. […] *hay mucho machismo, es como si el hombre es para trabajar y la mujer para la casa. Estamos acostumbrados a que la mujer haga todo, la que nos cuida, nos entiende, es como una tendencia de la sociedad mexicana*] (Gaby).

In this quote Gaby describes how the role of women as caregiver is highly engrained in Mexican society. Similarly, perceptions of inequalities were also expressed by students who shared that even if women work outside the house, society expects them to take full responsibility for the house. Fernanda described these inequalities,

> … For example, women who work also take care of the house, prepare meals, and do laundry. This means that in addition to working outside the home, they also work at home, and I feel that men don't—they get home, relax, and ask for something to eat and that's it […*pero por ejemplo las mujeres que trabajan también se encargan de la casa, hacen de comer, se ponen a lavar la ropa, o sea a parte de que trabajan llegan a la casa a trabajar y siento que los hombre no, llegan a su casa, se relajan, piden de comer y ya]* (Fer).

Participants were thus well aware of gender disparities and how their mothers—whether they worked outside of the home or not—had full responsibility to take care of their homes.

Although participants in this study stated they felt greatly supported by their families, they also revealed that their families often upheld traditional, stereotypical ideas about gender roles. While their mothers pointed out gender disparities, as shown above, they also at the same time upheld these traditional gender roles. Liz stated, for example:

> My mother thinks that women, in addition to taking care of the house, need to have an opinion and work hard, my mother has always worked [outside the house] [*Mi mamá opina que el rol de las mujeres debe ser aparte de ser ama de casa debe ser que pueda tener una opinión y este y ser trabajadora, mi mamá siempre ha trabajado]* (Liz).

Here Liz makes it clear that her mother does not simply see women as passive homemakers, as she stressed to Liz the importance of women having opinions, and having a job outside the house. However, Liz's mother does not question the fundamental responsibility of women to take care of their homes, and simply adds the additional responsibilities to this traditional one. Participants also believed that perceptions of gender roles are shaped strongly by Mexican families. Yolanda, for instance, shared that while living with her family she started to feel that her role as a female was different than her brother's. She also stated that her family transmitted to her the perception that she could not participate in activities that were "just for men":

> I think everything starts like that, it's not like a problem that can be solved superficially, it starts in the family when they start separating you, telling you "you do this because you are a little woman." [*Pues yo creo que todo empieza*

> *así, no es así como un problema que se pueda resolver superficialmente sino desde la familia, la familia desde que en tu casa te empiezan a separar de "tú haces esto porque eres "mujercita"*] (Yol).

In this quote Yolanda uses the term "*mujercita"* [little woman], which is very common in Mexican society. Although "*mujercita"* can also be translated as "young lady", I decided to use the first translation, "little woman" to emphasize how it is often used in a patronizing way, as it associates the female gender with inferiority.

In addition, some parents of the participants in my study expected their daughters to follow the traditional gender roles dictated by Mexican society. Although they supported their daughters' decisions to attend college and pursue careers outside of the home, they also expected their daughters to take on the role of family caretaker. Furthermore, some parents expect their daughters to work only until they have children, thus further reinforcing traditional gender role stereotypes. Cristy, for example stated:

> My mother is of the opinion that when I finish [college] I should work for a while but when I get married, for goodness sakes, I should leave the job! [*Mi mamá es de la opinión de que cuando salga trabaje un tiempo y demás pero ya que me case pues ya deje el trabajo ¡por la paz!*] (Cri).

Cristy in this quote shares how her family, especially her mother, supports traditional gender roles and expects her to take care of her family full time.

Nevertheless, what is common among the students interviewed is the support they all have from their immediate families. Families play an important role in Mexican culture as they are seen as a motivating force and a source of support (Achor & Morales,

1990). Participants also stressed that their parents supported their siblings, as well, and all but one of participants' college-age siblings are in higher education. Participants agreed that their families played a large role in their persistence in college. The support they felt from their families ranged from supporting the idea that they wanted to study engineering, to encouraging them to leave home to pursue their studies. Participants especially stressed how their families encouraged them to be happy and to pursue a field that they liked or enjoyed the most.

Mothers are mentioned by the participants as their main support; participants stated that their mothers encouraged them to continue, trusted them, and supported the decisions they made. It is important to note that some mothers were not able to go to school themselves for a variety of reasons, including getting married and having to play the traditional role of homemaker, not having the opportunity for higher education, or not having the support of their parents. Participants' mothers who did not have any higher education were more concerned about their daughters' independence and well being. Often feeling regret about their own choices, these mothers advised their daughters about life and the importance of being self-sufficient. Gaby's quote is representative of these beliefs:

> [My mother] saw the problems this limitation posed to her, maybe the opportunities for looking for a job or to work in something were limited because she didn't go to college, that is why since we were little she made us …like… committed [to school] [*[mi mamá] vio los problemas que le causaron tener estas limitantes que a lo mejor pues las oportunidades para buscar un empleo o para*

> *dedicarse a cierta cosa se veían limitadas por no tener una carrera, ella por eso nos hizo desde chiquitos …como… muy dedicados*] (Gab).

Similarly, Ivonne, described her mother's experience,

> Well, in fact my mother has always encouraged us [daughters] to study so we can eventually have good jobs, and not be dependent on a man, like it has always been in the family. [*Bueno, el hecho de que mi madre siempre nos ha incitado a estudiar para que eventualmente trabajemos y que no dependamos siempre de un hombre, como, bueno como en la familia siempre ha existido*] (Ivo).

Two of the students interviewed have children and have received a great deal of support from their mothers and mothers-in-law, who baby-sit their children while they are in school. In all cases, participants shared their mother's awareness of the opportunities that higher education can give to their daughters, including independence and well-being through employment.

Students also stated that although their immediate family supported them, other relatives and friends made negative comments about being a woman in engineering. These comments ranged from "it is going to be more difficult because you are a woman" [*va a ser mas difícil porque eres mujer*] (Car), to "why do you study if you are going to stay home and take care of your children?" [*¿Para que estudias si te vas a quedar en tu casa a cuidar a los niños?*] (Ivo), or even concerns about young women leaving home to go to college.

In contrast to their parents, participants in this study did not embrace strictly traditional gender stereotypes. Participants stated, for instance, that work needed to be divided according to ability, not according to gender. Two students stated, for instance,

> It [work] needs to be balanced, men and women should cooperate, yes we have different capabilities and abilities, but we can make a team, like a couple or a family. I don't believe in stereotypes [*Debe ser un equilibrio, tanto hombres como mujeres cooperen, debemos encontrar un equilibrio, si, tenemos diferentes capacidades y habilidades podemos hacer como un equipo, como una pareja o una familia, yo no creo en estereotipos*] (Fer).
>
> I think that it's like an organization, first the couple, you must have balance and also teach the children the same, that balance should include everybody. [*Yo creo que es como en una organización, primero la pareja, debes tener un equilibrio y también enseñar a los niños lo mismo, este equilibrio debe incluir a todos*] (Ama).

Challenging traditional gender roles was more important for participants when they mentioned life choices. When they referred to their future life, they talked about balancing work and family responsibilities and finding time for having and raising children. They recognized the pressure Mexican society poses on professional women engineers, and stated that working women are negatively perceived and judged by Mexican society, which holds stereotypical views of women and expectations about their roles in the family and the workplace. Ana illustrated these perceptions:

> Women in Mexico are kind of rejected in some ways. I think it is cultural. Whatever you do it will be wrong [according to society]. If you work, they'll say and "What about her children?" and if you don't work they will say "What a waste!" Engineering is very demanding; and you need to balance work and family [*Las mujeres en México son como rechazadas. Yo creo que es cultural. Lo que hagas esta mal. Si trabajas dicen ¿y los niños? Y si no trabajas dicen ¡Que desperdicio! Ingeniería es muy demandante y tienes que balancear el trabajo con la familia*] (Ana).

In this quote Ana recognized that she will have to negotiate within two culturally imposed impulses within herself—rejecting traditional norms by being willing to work outside the house while at the same time embracing them by raising her family.

Like Ana, participants shared how they experienced contradictory forces. On one hand, the students as stated before enrolled in engineering colleges rejecting and challenging traditional gender roles. They believe that higher education, especially engineering studies would allow them to find a job outside the house and have a professional life. On the other hand, the female students also described the tension they experience in the negotiation of their perceived demanding professional lives and their roles as family caregivers. Thus participants were constantly negotiating between rejecting traditional gender norms and upholding the norms that are so deeply engrained in Mexican society.

Additionally, participants discussed how traditional, stereotypical attitudes about gender roles and expectations have affected them in the workplace. They stated, for

instance, that they had worked in jobs where they did not feel accepted because they were female; they also argued that stereotypes against women help structure the job market and the job opportunities available to women. For example, some women decide to stop working to take care of their families, and this situation can hurt job opportunities for women. Paty explained:

> It's like companies don't see a woman as a long term investment. It's harder for women; men do not have other responsibilities. I want to have a family of course! But I want to work too; I will not stop working, that's why I'm studying so hard. *[Es como si las compañías no vieran a las mujeres como una inversión a largo plazo. Es más difícil para las mujeres, los hombres no tienen otras responsabilidades. ¡Si, claro que quiero tener una familia! Pero también quiero trabajar. No voy a dejar de trabajar, por eso estudie tanto*] (Pat).

Paty nicely illustrates the strength of gender stereotypes, and demonstrates how these students are constantly negotiating and struggling, trying to break the stereotypes.

In contrast, some participants also asserted that Mexican society is changing and they have seen jobs where females were preferred. Most of the students had not encountered problems while looking for a job. They believed women are preferred in some jobs because they are more responsible and hard-working than men. Paola, for instance, stated her belief that women who decide to study engineering are self determined and have a strong desire to succeed. According to participants, these beliefs are shared by engineering firms that look to employ women.

Gender roles were seen by the participants as part of Mexico's masculine culture and they recognized that society's perspectives are present in their families and have impacted the job market. Challenging these gender role stereotypes seems to be more difficult when the participants talked about life choices. Some participants shared their desire to raise a family and also work outside the house. Although they see in higher education a way to challenge these roles, they recognized engineering as very demanding and the need to balance work and family. In addition to gender roles, the participants were aware of other cultural stereotypes that affect women students in engineering, as I describe in detail in the next section.

Stereotypes of Women in Engineering

Another manifestation of the masculine culture in Mexico are cultural stereotypes that create extra stress for female engineering students. Female students have an extra burden dealing with the possibility that their performance might confirm the stereotype of female inferiority and that they may be judged according to that stereotype. Mexican female students in engineering also must deal with cultural stereotypes about women's inferior math and science aptitude and superior ability to take care of the house and children. In addition, female students deal with the stereotype of being perceived as "unfeminine" and the "least attractive" students of the university.

Participants recognized attitudes grounded in and reinforced by Mexican cultural stereotypes, which perceived women as weaker than men. Evelin, for instance, stated:

> …[I think] it is a society behavior and finally there is always the belief that girls are less strong, for example when they say that women can't drive, it is like [we

> are] below them [male-students] then they feel displaced or they feel that you are taking their place [*porque es un comportamiento de la sociedad y finalmente siempre es una perspectiva de que las niñas siempre tienen menor fuerza, por ejemplo cuando dicen que las mujeres no saben manejar, …como que es un poco debajo de ellos, entonces como que se sienten desplazados o como que se sienten que les ganan el lugar*] (Eve).

According to participants, these cultural views of female inferiority lead men to feel they have to "look after" the women who are close friends or family members. These attitudes and behaviors were present in the university setting and in the classroom, and participants in this study perceived that their male classmates tended to "protect them." Olivia stated, for instance:

> … because of machismo, although [the environment] is competitive, they [male students] tend to protect you, yes even if it is competitive, they think we are their property, and in this sense they support you a lot. I think this belief is not common in other places [*también por el machismo te protegen, si aunque sea competitivo [el ambiente] ellos piensan "esto es mi propiedad" y en ese sentido si te apoyan muchísimo, eso sí creo que no se da en otros lados*] (Oli).

Similarly, participants shared how women are perceived in society as having less natural aptitude for math and science, and consequently for engineering. Female students in engineering are still faced with stereotypes, as Ana stated:

> They tell you, 'Engineering? You? A woman??' Yes, I think society plays a role. It is strange and, of course, it can affect you. It is like a culture; engineering is

> difficult and in this culture it is seen as difficult for you [as a woman] to succeed. [*Y te dicen, ¿ingeniería tu?, ¿una mujer? Si, yo creo que la sociedad juega un rol importante. Es raro por supuesto, y puede afectarte. Es como una cultura, que ingeniería es difícil y ven difícil que [como mujer] la puedas hacer*] (Ana).

This perception led participants to feel social pressure, starting back in high school. Participants stated that society's expectations of young women who decide to study engineering were different from those of young men. Young women in high school are expected to have good grades in order to avoid comments doubting their success in engineering colleges. In contrast, young men are expected to succeed in engineering. As Cristy argues:

> Men can decide to study engineering or whatever they like without any problem, they don't need to be good [students]. People told me, ok since you are [a] good [student] you are going 'to make it' [in engineering] [*Los hombres pueden decidir estudiar ingeniería o lo que quieran sin ningún problema, no tienen que ser buenos. [A mi] me decían, bueno [como] si eres buena [estudiante] "si la vas a hacer"*] (Cri).

Female students in this study were aware of the inequalities between men and women in the engineering environment before they entered college. They learned from an early age that in order to avoid the social pressure and demonstrate their "belongingness" to an engineering program they needed to obtain good grades. This need to prove to themselves and to others that they re capable and that they belong to

engineering programs starts in high school, but continues throughout the college years, as I describe in the next section.

For Mexican society, engineering, as stated before, is still seen as a profession unsuitable for women. Participants perceived social barriers to becoming engineers, and stated that often female engineering students are seen as "tomboys." Congruent with the literature (Powell, Bagilhole, Dainty & Neale, 2004) participants described how they were portrayed as masculine or unfeminine by their peers and by society at large. Olivia shared her experience,

> I like engineering a lot, but sometimes they say women should not do that [study engineering]. A former boyfriend told me that if you study engineering you are a tomboy. He said, "What, do you like women?" Not everybody understands. [*A mi me gusta mucho la ingeniería, pero bueno a veces dicen que algunas mujeres no deberíamos hacer eso. Un novio me dijo si estudias ingeniería eres machorra ¿Qué, te gustan las mujeres? No toda la gente entiende*] (Oli).

These cultural stereotypes pervade universities in Mexico, as well, as they embrace an image of female students in engineering as being physically unattractive. All participants agreed that in their universities there was an image of female engineering students as the least appealing of all female students across the campus. The stereotype of women in engineering is described by participants as the typical girl who has glasses, does not take care of herself, and does not have a social life. The students agreed that related to the "ugly" image there is also the "*ñoña*" image which portrays female

engineering students as not having a social life, being shy, and being introverted. Paola, for instance stated:

> It's like she is someone who goes to the library. They think she is a bookworm, and they start thinking that if you are at the library and you have a scholarship, well, you're boring. And if you're boring you're not pretty, as generally pretty persons are seen as more cheerful. [*Es como si alguien que va a la biblioteca es así como que ¡uy! Un ratón [de biblioteca] y ahí empiezan a creer que si estás en la biblioteca y si tienes una beca, pues eres aburrida y eso también ser aburrido no es de una persona guapa, generalmente las personas bonitas son mas alegres*] (Pao).

These stereotypes are so strong and pervasive that some participants also seemed to believe them. For example, some participants accepted the stereotype and believed that beautiful women do not study engineering. One student stated that "the pretty girls, the most pretty girls, maybe they study other things" [*las niñas bonitas, las mas bonitas quizá si estudian otra cosas*] (Gab). Also in keeping with the stereotype, but in a more "positive" interpretation of it, participants stressed the value of intelligence over beauty and associated beauty with superficiality. A mechanical engineering student shared that for her "intelligence is more important than a pretty face" [*la inteligencia es mas importante que una cara bonita*] (Ama). Similarly, participants argued that female students in other majors devote much more time to their physical appearance. They identified the attention to personal looks as superficial and associated this attitude with

particular majors, thus engaging in stereotyping other women. For instance, Lulu argued that,

> [Female] students in international affairs and things like that, they pay more attention to their personal looks, they are more superficial, they care about clothes and trends. I feel that they are more superficial than [female] students in engineering [*Las que estudian negocios [internacionales] y cosas así se arreglan mas, tienen una forma de ser mas superficial, la ropa, las marcas, siento que son mas superficiales que las que estudiamos ingeniería*] (Lul).

Furthermore, participants talked about paying less attention to their personal looks, supporting this attitude by saying that their focus is on their educational goals. For example, Ana explained:

> …another joke "if you don't have a moustache you are not in engineering." Maybe we are more in our place; if you are going to school you don't need to pay that much attention to your personal look, or maybe five more minutes of good sleep… [*Otra broma, "si no tienes bigote no estás en ingeniería" A lo mejor nostras estamos mas en nuestro lugar, si va a la escuela no necesitas poner tanta atención a tu arreglo personal, a lo mejor cinco minutos mas de sueño…*] (Ana).

Defying the stereotype that engineering students are not attractive, however, participants described themselves in all cases as capable, intelligent, and pretty. And despite having just stated that women in other majors who care about their looks are

superficial, they all stated that they like themselves looking pretty and that when they "go out" they tend to pay more attention to their personal looks:

> What woman does not want to see herself beautiful? [*¿A que mujer no le gusta verse bonita?*] (Ama).
>
> When we go out, yes we wear a skirt and heels [*Cuando salimos sí nos ponemos falda y tacones*] (Car).

Theses quotes illustrate the participants' rejection of the stereotype by striving to be both pretty and engineers. However, they are also embracing the social pressure that women "should look pretty."

In summary, participants in this study were aware of the masculine culture present in the Mexican society and the different ways it is manifested. This masculine culture influences the engineering college environment which the participants encounter as challenging and hostile as I describe below. Despite this, women decided to enter and engage in engineering colleges, and to work against the norms. Participants in this study have a strong desire to finish college and have learned to develop confidence in their abilities. In addition, they have found in their engineering colleges different sources of support that helped them stay in their programs as I describe below.

Engineering Environment

Enrollment in engineering colleges in Mexico is dominated by male students. A 2004 report from ANUIES stated that 30% of the students in engineering and technology are female. It is important to mention, however, that this percentage also includes

architecture and design, majors in which women participation is higher than in engineering. The colleges of engineering in my study had an average of 20% of female students in 2006. Different engineering programs in Mexico have different percentage of women participation. García Guevara (2002a) states that the difference between enrollments in different engineering programs is related to the traditional roles women have in patriarchal Mexican society. Although ability and interest in math and basic sciences drive the election of an engineering major, some types of engineering are considered more female-oriented, for example computer science or industrial engineering, where woman participation can achieve 30%. According to García Guevara's study, these programs offered options for professional development that are more accepted in the society—for example, the introduction of computers in the daily life, and the wide options that industrial engineering offers for professional development, such as management positions in the industries, and marketing and business of industrial products. In contrast, some other engineering programs like civil or mechanical have less female participation. For example, Mexican University's mechanical engineering program has only 6% of females enrolled, and similarly in International University's enrollment is only 9%. According to García Guevara these programs offer a work environment which is "dirty" and is seen by the Mexican society as less suitable for women. Some of the students interviewed for this study, especially mechanical engineering students, were the only female in their class. The situation for women in this context dominated by men is complex.

The college of engineering environment is perceived by participants as very challenging. This challenge has two dimensions: academic and social. In addition, participants described the dual role faculty and peers play in their retention. In one hand women still faced discrimination in the college coming from faculty and peers, while in the other hand they found in faculty and peers the most important sources of support. Finally, female participants in this study do not see the role of the institutions in their retention as very strong, as I describe below.

Challenging Academic Environment

The first dimension of the challenging environment identified by the participants is *academic*. Students are faced with subjects that are difficult to learn and they realized early in the program that they needed to study hard. Academic challenge is documented in the literature as one of the main causes for college student attrition, and is also one of the most discouraging factors in pursuing an engineering career (Duncan & Zeng, 2005). It played a big role in the doubts participants experienced about their academic abilities and their "sense of belongingness" to the program in their first years of college. Uncertainty is cited in literature as a difficulty for women in general (Johnson-Bailey, 1999), who often doubt their ability to succeed in school. Participants shared that when they started their programs they tended to self-disqualify when they made bad grades. They also stated that bad grades were perceived differently by men than by women in engineering programs. Participants explained that if male students got bad grades they tended to blame it on the teacher, or on the quiz. However, when women got bad grades they tended to internalize failure. As Maria described:

> … [For women] it is like a need to prove that you are good for engineering. They (the male students) have more confidence, is like if they know they are going to graduate…. I was more affected by bad grades than men, maybe because we women are more sensible and because the society says it is harder for you [as a woman] […] *[Para las mujeres] es como una necesidad de probar que eres buena para ingeniería. Ellos tienen más confianza, es como si ellos supieran que se van a graduar… A mi me afectaban mas las calificaciones bajas, a lo mejor porque las mujeres somos mas sensibles o porque la sociedad dice que es mas difícil para ti [como mujer]*] (Mar).

Similarly, the rigor of the curricula of the first two years of the engineering program contributed to the uncertainty the participants experienced. The high rates of attrition that are part of engineering colleges in Mexico, and the "weed out" courses along with faculty comments about the "elitist" environment and the difficulties of an engineering major contributed to the fear and intimidation experienced by participants. In the first years, as Maria explained, the difficulty of the learning the material contributed to the uncertainty many students felt:

> First, at the personal level, because the major is very demanding, it takes more for you every day… and each day or each step is more difficult than the last one, and there is a moment when you feel cornered or tired, and you really ask yourself if you are going to make it…[*…la primera nivel personal porque la carrera o la escuela de ingeniería es una escuela bastante pesada, exige cada día mas … cada día o cada paso es mas difícil que el anterior y llega un*

> *momento en que te sientes acorralada o cansada y que de verdad te preguntas si vas a poder…*] (Mar).

In addition, high school preparation contributed to the challenge students experienced as they entered college. Even though all of the students interviewed had good GPAs in high school, the students differed in how well prepared to enter college they perceived themselves to be. Some students stated that their high school preparation in math, physics, and even computer science was very strong, which made their first year in engineering not very challenging. In contrast, some students' high schools were more directed towards humanities, so they struggled when they started college. The rigor of the engineering curriculum lowered some participants' academic performance. Georgina stated, for instance,

> I felt a big difference with high school; here I even failed [a course]. In high school I had a 95 [95/100 grade average]… I didn't feel I was well prepared academically […*sentí mucha diferencia con lo que era la prepa y aquí llegue a reprobar, en la prepa tenia 95 [95/100]… No sentí que estuviera bien preparada académicamente*] (Geo).

However, participants embraced these challenges. When discussing their decision to study engineering; most participants stated that they decided to study engineering when they were in high school. Participants referred to what they called "*the challenge*": the challenge of mastering difficult subjects, of solving practical problems, and of creating things that work. The selection of an engineering major was

accomplished by their self-perceived strength in difficult classes such as math and science taken in high school. As Lucy explained:

> … In high school I enjoyed math and physics, also chemistry. I decided that what I really wanted was engineering, I wanted a major that required intellectual challenge, and I found mechanical engineering had the challenge. It does not limit you, I like to develop and create new things. [*En la prepa me gustaba matemáticas y física, también química. Decidí que lo que realmente quería era ingeniería. Yo quería una carrera que requiriera un reto intelectual y encontré que mecatrónica tenía ese reto. No te limita, me gusta desarrollar y crear cosas nuevas*] (Luc).

Participants shared how they were able to use strategies to persist in their university programs. The availability of academic support, especially in the form of tutoring is documented in the literature as important for student retention (Duncan & Zeng, 2005; Tinto, 2005). For instance, the students were aware of the tutoring and counseling services given by the universities. Some students took advantage of the tutoring programs offered and recognized them as very helpful. The students attended tutoring not only when they needed to understand some concepts, but also when they were not able to attend classes. The tutoring sessions were often given by upper-class students and some students who were interviewed were tutors in their last years.

In contrast with previous studies that suggest that beliefs about abilities tend to be associated with unwillingness to persist in the face of obstacles (Heyman, Martyna & Bhatia., 2002) and in agreement with Dweck's (2006) theory on motivation, participants

in this study believed that when encountering difficult subjects what was important was the effort they put in studying and the interest they have in the subjects. Students believed that working hard allowed them to fully use their abilities. In addition, participants agreed that abilities can be developed and learned, as they stated:

> … in any subject while you keep trying and if you try hard, do your homework and study for the exams [you will do fine] [… *[en] cualquier materia mientras trates, te esfuerces y entregues las tareas, estudies para los exámenes [puedes salir bien]*] (Yol).
>
> It is like with any ability, for me maybe you have not had the appropriate situation to develop it; it is not that one [person] can do it, and the other no. I think that we all can but it depends on the effort each one puts on it. [*Es como cualquier habilidad, para mi a lo mejor no has tenido las situaciones favorables para que las desarrolles no es de que uno si puede y otros no, yo creo que todos podemos pero depende del empeño que cada quien ponga*] (Lul).

Furthermore, students' beliefs that abilities can be developed helped them decouple or disassociate gender from math and engineering ability. These perceptions were used by the students as a strategy to fight cultural stereotypes. As Paty explained,

> Intelligence and abilities can be developed; it is not like what you are born with. No! They [abilities] can be developed and school helps. [*La inteligencia y las habilidades se pueden desarrollar, no es como si naciste con ellas. ¡No!, se pueden desarrollar y la escuela ayuda]* (Pat).

Facing academic challenges, participants reflected in their students' experiences and how they were able to develop the abilities needed to succeed in college. First, participants described how they learned to be tolerant and perseverant. One student shared:

> Many subjects are very difficult to understand and you need a lot of concentration to understand the problems and concepts, it is necessary to be constant and perseverant, and if you fail once you continue, try again… I think it is tolerance [to failure] [*Muchas cosas son muy difíciles de entender o necesitas mucha concentración para entender los problemas y conceptos, se necesita ser constante y perseverante, si fallas una vez pues le sigues, tratas otra vez… Yo creo que es tolerancia [al fracaso]*] (Geo).

Sometimes participants had difficulties dealing with failure, and they found they needed to re-evaluate their study habits and made adjustments, and gain more realistic views of themselves. Students learned how to recognize their weaknesses and how to strengthen those areas. They were also able to learn that perfection in all subjects and activities is impossible and to deal with difficulties. As the students described,

> At the beginning there were a lot of classmates that had more abilities [than me], but I have always been a perfectionist… The most difficult [thing] was to realize about your weakness and how you can turn those [weakness] into strengths [*Al principio si había muchos compañeros que tenían mas habilidades [que yo], pero yo siempre he sido así perfeccionista… Lo mas difícil es darte cuenta de cuales son tus debilidades y como se pueden convertir en fortalezas*] (Cri).

> When I started the program I was… yes… I tend to be very perfectionist and if I couldn't do something I would get frustrated and I cried, and here is what you need to learn is that if you can't do something you try again and you need to be patient and work a little bit more. [*Yo al principio era muy dada a que si, soy, tiendo a ser muy perfeccionista, entonces si no me sale algo estoy frustrada y me ponía a llorar, y como que aquí lo que tienes que aprender es que si no te sale pues vuelves a intentar y como que a tener mas paciencia y a dedicarle un poquito más]* (Gab).

Participants saw themselves becoming more analytical thinkers, and described how this ability helped them analyze situations and apply what they have learned to propose different ways to solve problems. In addition, they noted how this thinking had permeated their lives. One student shared, for instance,

> We analyze everything; we are used to seeing all the factors, any factor even if it seems insignificant can be the cause, then we [female students] are like open to everything. [*Analizamos todo, estamos acostumbradas a ver todos los factores, cualquier factor por insignificante que te parezca puede ser la causa, entonces nosotras estamos así como que abiertas para todo*] (Geo).

This quote illustrates the students' self-perceptions of growth and how they became more self-confident in their abilities.

As students advanced in the program, self learning was seen as very important to them. Their perceived self learning ability helped them gain self confidence. Students shared that they needed to learn how to learn in order to solve the problems.

> …it is like if I needed to do something, for example a project, I need to know what to look for, how I can complete it, and how I can be able to learn or understand the problem. [… *es como si tengo que hacer algo, por ejemplo un proyecto, necesito saber que buscar y como puedo completarlo, como puedo aprender y entender el problema*] (Ili).

Participants in general were self-confident about their intellectual capabilities. The challenge of mastering difficult subjects gave the students a sense of pride, and most students shared that among their best experiences were how they were able to succeed in those subjects. They stated:

> All my positive experiences are about how I feel good when I pass all the tests with good grades, especially if the classes are difficult [*Todas mis experiencias positivas son acerca de que me siento bien cuando paso todos mis exámenes con calificación satisfactoria… sobre todo si las clases son difíciles*] (Liz).
>
> Sometimes you needed to take time away from family and friends to study, but yes, it was worth it. [*A veces tienes que quitarle tiempo a la familia y a los amigos para estudiar, pero si ¡valió la pena!*] (Gab).
>
> It requires hard work and personal effort, but at the end it's good to know that I finished because of my ability and my effort. [*Requiere mucho trabajo duro y esfuerzo personal, pero al final es bueno saber que si terminé, por mis habilidades y mi esfuerzo*] (Car).

Challenging Social Environment

The second dimension of the challenging environment identified by students is *social*. Female students in engineering stated that they face an environment that is competitive, individualistic, and isolating. Additionally, students perceived that their workload led them to have less time for social life than students in other majors. Cultural values also reinforced this perception, since engineering students are perceived as nerds who have no social life (Loshbaugh & Claar, 2007).

Engineering faculty and society in general have the elitist notion that engineering is superior to other professions. Several of the participants shared how they constantly receive admiration of friends outside the college. However, the strict and competitive environment described by participants can be a challenge for students entering the engineering college, especially for women who can feel isolated in this environment. Participants observed a *competitive environment* and discussed how male students felt threatened by good female students. They reflected on their experiences and expressed that male students wanted to prove themselves and show that they were better than the female students. Lulu stated, for instance,

> They [the male students] were … like always wanting to impose, like my [computer] program is better, or I'm the only one who can do this [*Ellos como que siempre querían imponerse ¿no?, así como mi programa es mejor o sólo a mi me sale bien esto*] (Lul).

Similarly, participants shared feelings of distrust coming from their male peers:

> They [male students] wanted to do the "thinking part", it was like we [female students] won't be able to do it right [*Ellos como que querían hacer "la parte pensante", era como si nosotras no lo fuéramos a hacer bien*] (Cri).
>
> They [male students] thought that we [females] don't know how to do things, or that we are not good for computers, even if normally our grades were better [*Ellos pensaban que nosotras no sabíamos como hacer las cosas o que no éramos buenas para las computadoras, aunque normalmente sacáramos mejores calificaciones]* (Pao).

In this environment, participants described how they focus on proving that they can do the work, showing an "image of a good student," and obtaining good grades in order to be trusted and recognized by their peers. Paola, shared, for instance,

> At the beginning I didn't pay attention, but the environment created the need to demonstrate that we are equal. First the teams, that's typical, if they [male students] do not know you or don't know how you can be useful they don't even consider you, and if they don't consider you, you are like a ghost…. [*Yo al principio me daba igual pero el ambiente fue creando que fuera necesario la demostración de que somos iguales. En primera pues los equipos, eso si es típico, si ellos no conocen o no saben que puedes ser útil de plano no te consideran y si no te consideran de plano eres como un fantasma…*] (Pao).
>
> The following conversation expands this idea:
>
> Paty: I took a class with a professor I knew, but I didn't know any of the students. The very first day, the professor asked me to join a team [all male

students]. You should see their faces [male students in the team] …. They were thinking "Damn! We will need to deal with *this* [female] student." So for the first homework I worked very hard, you should see it, not to show off, but it was very good. I sent the homework to the team group, and yes! They recognized my good work. They even asked me if I was an engineer [student]

Interviewer: So not everyone was studying engineering in the class?

Paty: No, some students were majoring in information management systems.

Interviewer: Do you think doing that first homework by yourself was worth the effort?

Paty: Oh yes, after that I never had a problem finding a team. Now, they [male students] ask me to join them, and I was able to find good teams where everyone does his/her part.

Paty: Me metí a una clase con un profesor que ya conocía, pero no conocía a ninguno de los alumnos. El primer día el profesor me pidió que me uniera a un equipo [solo de hombres]. ¡Hubieras visto sus caras! [de los estudiantes del equipo]… Estaban pensando "chin ya nos enjaretaron a esta." Entonces para la primera tarea yo trabajé mucho debías verla, no es por nada pero me quedo muy bien [la tarea]. Les mande la tarea [al equipo] y si reconocieron que estaba muy bien hasta me preguntaron si era ingeniera.

Interviewer: ¿Entonces no todos los alumnos estudiaban ingeniería en esa clase?

Paty: No, algunos eran licenciados en computación [administrativa]

Interviewer: ¿Tú crees que valió la pena hacer esa primera tarea?

> *Paty: Por supuesto, después de eso no he tenido problemas para encontrar equipo. Ahora me preguntan si quiero estar con ellos y puedo escoger equipos donde cada quien hace su trabajo* (Pat).

Paradoxically, some female students enjoyed this competition, and used it, again, as a way to prove themselves. Yolanda, for instance, stated:

> …about the competitive environment I think sometimes it is fun, because for women it is a challenge to prove that we can do our work equal or better than others [even among women] [… s*obre el ambiente competitivo creo que en ocasiones resulta divertido para las mujeres porque es un reto demostrar que podemos hacer el trabajo igual o mejor que los demás (incluso entre las mujeres)*] (Yol).

Participants were aware of the competitive environment present in engineering colleges and as with other dimensions, the students take this challenge as a way to prove themselves and others that they are capable and especially equally capable than men. However, when they relate this challenge to the Mexican culture, participants shared how women can be influenced by cultural values, and how success in the engineering environment can have negative consequences for them such as social rejection, or can inhibit potential romantic relationships. Yolanda explains,

> … however, … it is difficult to do that [compete with others] …. a lot of them [men] feel less and even in romantic relationships [this competition] can inhibit men, so many women stop competing […*sin embargo… es muy difícil hacer eso [el trabajo mejor que los demás]…, muchos [hombres] se sienten menos e*

> *incluso en relaciones amorosas eso cohíbe a los hombres, así que muchas mujeres dejan de competir*] (Yol).

Gaby expanded the concept of social rejection when she shared how being a good student in her first years of college gave her an image of being arrogant among her classmates:

> … because of the same [very good grades] in the first years many people started to look at me like "the nerd" it was like they didn't like me. That's the impression I have, that they [male students] felt that I was presumptuous… but that has never been my intention. [… *por lo mismo [mis buenas calificaciones] en los primeros semestres mucha gente si me empezó a ver como no se si como la "nerd", como que no les caía yo bien, es la impresión que yo tengo, que sentían que ero yo no se si presuntuosa,… pero pues esa nunca ha sido mi intención*] (Gab).

In addition to competition, the participants perceived an *individualistic environment* where they experienced feelings of isolation. Evelin for instance, expressed her isolation in her first years of college. She stated, "in the Annex [first years] yes there were times that I was alone everywhere, always looking for the way to learn" [… *[en el anexo] si había veces en que andaba solita por todos lados, siempre buscando la forma de aprender*…] (Eve). Participants stated that within the university, engineering students are perceived as isolated individuals. Students discussed the low participation of engineering students in social events—even those organized by the college—and argued that engineering students are seen in the university environment as not very social. When

participants compared their engineering students' social experiences with those of students in different majors, they perceived that social life is easier in other majors because even in school (academics), it is considered important to learn to socialize. Paola explained:

> … but in other majors, it is easier simply because they manage social relations and because it is part of their job to know each other and how to interact. In contrast, we even say engineers are the ones who use the library, the *"ñoños"* [nerds] [… *pero en otras carreras es mucho más fácil simplemente por que manejan mucho las relaciones sociales porque es parte de su trabajo de conocer, de saberse como llevar, y en cambio nosotros hasta ahí mismo lo dicen "los ingenieros son los que usan la biblioteca" y los ñoños*] (Pao).

This image of "*ñoños*" or nerds and engineering students as not very social is supported by participants' comments about how students in engineering tend to get together more for academic reasons like for doing homework or a team project rather than for social interaction. Lulu, for instance explained,

> I think our social life is more academic, not that social… and I think that this class does not go out a lot, then yes it was more academic [*yo creo que la convivencia era mas académica, no tanto social,… yo siento que esta generación no sale mucho, entonces si era mas académico*] (Lul).

Furthermore, participants stated how the lack of time to participate in social events due to the students' challenging course schedule contributes to the isolation students experienced in college. Paola's comment was typical among the participants:

> …well I was a little bit alone and also I was very interested in studying, and I didn't pay attention to others [… *entonces estuve un poco sola y además me interesaba mucho estudiar y entonces como que no hacía caso a los demás*] (Pao).

Lulu, expanding the idea, shared that she was not able to go with the other students in her dorm, because she had homework—she perceived that her roommates had more free time for fun and to go out:

> I live in *Colegios* [the dorm] with girls in different majors and many times I was like "I can't go out anywhere because I need to work in this project", and they [female students in the dorm] said, "Yes, let's go to the movies or to the *antro* [club]." I feel that they have more free time, and they enjoy it. I don't know, they have more time for fun, going out, and things like that, more than people who study engineering [… *yo vivo en Colegios entonces convivo con otras niñas que son de otras carreras y muchas veces yo era así de que "hoy no puedo salir a ningún lado por que tengo que hacer este proyecto" y ellas "sí, vámonos al cine, vámonos al antro", o sea, como que siento que sí tienen más tiempo libre y pues lo ocupan, no sé, pues tienen más momentos para divertirse y salir y esas cosas que muchas veces que las personas que estudian ingeniería*] (Lul).

In addition to the intense coursework, and the image of engineering students as "nerds," the low participation of women in engineering programs contributes to the lack of social life experienced by female students in the college. Some students, as stated

before, were the only females in their class, and they shared their need for female friendships. As Claudia explains, for instance,

> …Yes, and still now I will love to be like my sisters. They have a lot of [female] friends [in college] and it is really cool, and I, in that aspect I feel that I'm more shy, yes I have a lot of [male] friends, but we always need that, your [female] friend, your [female] best friend… [*Sí, yo hasta ahorita me encantaría ser como mis hermanas que tienen un chorro de amigas [en la universidad] y salen y conviven y se llevan súper padre y yo en ese aspecto siento que soy más retraída, sí tengo muchos amigos y todo pero siempre necesitamos eso de tu amiga, tu mejor amiga*] (Cla).

However, their experiences of isolation tended to disappear when participants found a good working team, which gave them much needed social support. Some students shared their experiences:

> If I had had the [academic] work team that I have now from the beginning maybe my life would have been different [*Si hubiera tenido el equipo de trabajo que he logrado ahorita desde que yo entré al Anexo a lo mejor mi vida hubiera sido distinta*] (Eve).
>
> At the beginning [of the program] I was scared, but after a while I realized that all my friends were "boys"; yes I have very good friends. [*Al principio tenia miedo, pero después de un rato me di cuenta de que todos mis amigos eran niños; si y tengo muy buenos amigos*] (Caro).

Participants shared how they were able to establish good academic working teams, where they can trust each other and how even if these relationships started as academic experiences they were able to established meaningful friendships. Gaby for instance explained,

> … well the friendship I was able to form well I think they were because I was able to relate [to students] in and out the classroom because of the [school] projects; I found classmates with whom I integrate no only for the work aspect, but also for personal aspects [*bueno las amistades que formé pues yo creo que fue …[porque] pude convivir tanto afuera como dentro del salón de clases dados los proyectos, encontré compañeros con los que me pude integrar muy bien no solo en el aspecto laboral sino en el personal*] (Gab).

In this section I described the two dimensions of the challenging environment faced by female students in engineering colleges in Mexico. First students encountered a very demanding academic coursework, and then a competitive and individualistic environment. In this environment the students were able to find sources of support and strategies to persist in their programs. For example, the students participated in academic support programs offered by the engineering colleges, they believed that the abilities needed to succeed in their programs can be developed with hard work, they focus on showing an image of "good students" in order to prove to themselves and to others they belong into to the program, and they were able to find good working teams that helped them build trust and friendship. I now turn the discussion to the role that faculty, peers and the institutions played in the retention of female students.

Role of Faculty

Research had found (Duncan & Zeng, 2005) that professors can drive or restrain the retention of female engineering students depending on the specific scenarios. Participants' relationships with professors varied; some professors were very supportive and encouraging and helped participants broaden their engineering views, while many participants reported discrimination and hostility with professors, especially during their first years.

Participants recognized the derogatory way some professors interacted with them, which took on specific characteristics when directed at female students. Some students reported that some faculty members insulted and humiliated students who asked questions during class. Some of the insults were directed towards the whole class (male and female students), like a professor who told the students that "they were the worst he had ever seen" (Eve), or a professor who stated that students were "garbage" (Pao). However, in some cases the insults were directed specifically toward female students. Participants perceived that faculty had biased attitudes against women. For example, a participant shared that when she went to see a professor after class for tutoring with her female friends, the professor's expression was "Oh! Here they come, 'the don't understand anything' girls" [*¡Ay! Ya vinieron, las no entienden nada*] (Ili). This expression, as stated in Spanish, "*las* no entienden nada" associates the lack understanding of the subject with only female students. In addition, the expression: "las no entienden nada" which I translated into "the 'don't understand anything' girls" is a

form of name calling and describes the pejorative way professors addressed the female students.

Another dimension of hostility experienced by participants is how they felt ignored or discounted by professors in their engineering classes. This form of discrimination was clearly identified by the female students I interviewed. For instance, Georgina explained how in a class where participation was part of the final grade, when women tried to participate in the class the professor tended to ignore them:

> … there was a rejection, an excuse, the excuse was "I don't ask you because of respect", "you do not pass to the blackboard because of respect", and I thought, "I want to participate, I am like them [male students]. I know the answer, I have studied", but there was always an excuse. I saw that as a form of discrimination [*…había un rechazo, un pretexto por encima, el pretexto era este "no te pregunto por respeto", "No te paso al pizarrón por respeto" Tu decías "pero yo quiero participar, yo también soy como ellos, yo también sé, yo también estudio" y siempre un pretexto por delante y a mí se me hacia una forma de discriminación*] (Geo).

This professor's attitude toward women is based on cultural values where woman should not be exposed or should be treated differently than men. This exclusion is seen by the participants as a form of covert discrimination.

Discrimination against female students was so strong that some professors even misinformed female students about their job opportunities and future professional development, stating that because they were female they would not have opportunities

and would not succeed. One student commented that a professor told her that she would not get admitted into graduate school because she was a woman. However, when the student got admitted into the program, she shared a sense of satisfaction in telling the professor she got accepted: "He was so astonished that I felt good" *[… fue tanto su asombro que en verdad me sentí bien*] (Ivo).

This example once again illustrates the ways participants worked against various forms of discrimination: to see them as obstacles to overcome. Again, as with the challenges, participants shared how they were able to prove to themselves and to faculty that they could succeed in engineering. For example, a student revealed that she stayed in the program because she wanted to demonstrate that "Ah! girls we can do many things" [*¡Ah! Pues las niñas si podemos hacer muchas cosas*] (Eve).

On the other hand, professors, congruent with the literature, are identified by the students as the most influential group in the university that affects retention. More specifically, faculty attitudes and behaviors affect retention, as faculty can contribute to student retention by being supportive of student's needs, being approachable, and responding to students in a timely manner (Lundquist, Spalding & Landrum, 2002).

As students advanced in their programs, they were socialized into the elitism of engineering, and began to embrace it. Participants experienced a shift in their student experiences and in their relationships with professors because of their perseverance. Upper class students felt recognized by their professors, and the participants agreed that the professors perceived them as capable, good students, and responsible. This change in perception gave confidence to students, as they explained,

> …as I entered directly to the major [upperclass], that is to move from the Annex to the Principal [building], it was different, the professors recognized that we [women] were good students --it was a change in mentality. […*cuando entré directo a la carrera, que es pasar del Anexo al principal, ya fue diferente, los maestros reconocían que [las mujeres] éramos buenas estudiantes, cambiaba la mentalidad* (Geo).
>
> It was great, great! Also now my project with Dr. G, Dr. S., and Dr. O is among the best experiences I have had. They are persons that motivate students a lot. [*¡Estuvo genial, genial! También ahora mi proyecto con la Doctora G, el Doctor S y la Doctora O es de las mejores experiencias que he tenido, son personan que motivan mucho a los estudiantes*] (Pao, 48].

Furthermore, the students' personal relationships with their professors motivated them to continue:

> Yes, because one thing are the classes and that one knows that they [professors] do know a lot, but when they share their [day-to-day] experiences you realize that they are persons that traveled the same road than us, that it was hard for them too, that they struggled, they didn't sleep, etc… Because there is a barrier between they [the professors] who are over there and have PhD's and us that we are still studying [as undergrads]. When there is an exchange of experiences, like what I have shared with them, it is encouraging to continue doing your job. [*Sí porque una cosa son las clases y que uno sepa que ellos saben mucho, pero a la hora de convivir te das cuenta que son personas y que recorrieron también el*

> *mismo camino que nosotros, que les costó trabajo, que no les iba bien, que no dormían, porque hay una como barrera entre ellos que están allá y son doctores y nosotros que apenas estamos estudiando, cuando hay una convivencia así como la que yo he tenido con ellos es más motivante para poder seguir haciendo el trabajo*] (Pao).

Finally, participants stated that with good female professors, the environment in the classroom changed. The male students tended to show more respect for their female peers and for their academic abilities. Liz explains, for instance:

> [Female] professors do not tolerate disorder or jokes in the classroom, and well they are more demanding [with students] than male professors, and sure that changes the environment a lot *[… las profesoras no toleran mucho que haya relajos o bromas en el salón de clase y este pues son más exigentes que los profesores, y si claro cambia mucho el ambiente]* (Liz).

> Women [professors] are more demanding; they don't let male [students] be rude. When women teach good engineering classes, they give prestige to the field. We [women students] feel good, it is like: See, and yes we can! [*Las mujeres [profesoras] son más exigentes y no dejan que los alumnos "se pasen." Si son buenas en las clases de ingeniería le dan como prestigio y nosotras nos sentimos bien es como que "¡ves si podemos!*] (Luc).

In this quote Lucy illustrated the role female professors can play in retention. They did not only encourage a good environment in the classroom, but they were also seen as role models for female students.

Good experiences with professors included good teaching and caring for students, participation in research projects, and friendships. The students recognized that most of their professors liked to teach and showed interest in the students' learning. One participant shared that she enjoyed the way professors had taught her, and how they were able to explain the difficult subjects; this student wants to be a professor.

Role of Peers

Similar to faculty relationships, participants cited peer relationships as a factor that was strongly related to their retention. On one hand, participants described situations where hostility came from male students and in the other hand they cited the importance of their classmates' support in their decision to stay. For example, participants relayed comments their male peers made about women in engineering and about their perception that women have less ability in math and science than men. These comments were seen by male students as jokes, but for female students were taken as derogatory. Paty explained,

> Once a female friend asked a question and a [male] student joked "of course, how will you be able to understand?", then he said "it was a joke." No, it wasn't a joke! [*Una vez una amiga pregunto algo y un compañero se burló, "¿Por supuesto como vas a entender?" Después dijo es broma. No, ¡no fue una broma!*] (Pat).

In this environment female students felt intimidated and did not feel confident asking questions in class.

Similarly, the image of lack of ability and distrust was covered up with a sense of protection. Participants perceived that male students' attitudes shown as caring and protective sometimes covered attitudes of distrust or beliefs that female students were not capable or could not do required activities properly. Yolanda explains,

> Well, because sometimes I think that, yes we [female students] needed to lift things or handle toxic substances in the chemistry lab, [it was] like they [male peers] didn't want [us to do it, they told us] "we will do it", maybe because, well I don't think so, well some of them because they thought I will do something wrong [*Pues porque a veces así como que pienso que, pues si teníamos que levantar cosas o tomar sustancias tóxicas en el laboratorio de química, como que no querían "mejor lo hacemos nosotros", quizá también, bueno no creo, pero pues algunos porque pensaban que lo iba a hacer mal* …] (Yol).

It is important to note that participants also perceived a contrasting attitude: some male peers tended to take advantage of female students who normally take good notes and do their homework on time. Cristy explained, "They [male students] just ask you for your notebook or homework and make photocopies" [*Ellos te piden el cuaderno o la tarea y la fotocopian]* (Cri). Furthermore, some participants shared that in projects that require team work, since female students are perceived as responsible and hard workers some male students did not work on their own parts, expecting instead that the female students would do the work for them. Female students cannot avoid the work because they need to constantly prove themselves. These attitudes shared by the participants show two sides of the same culture of patriarchy. On one hand, male students do not

trust females in some tasks and participants clearly perceived the distrusted attitudes of their male peers. On the other hand, male students took advantage and let the female students do much of the work for them.

In addition, Mexican male students tend to shout and use rudeness when talking to each other. Female students had experienced disrespectful attitudes toward them, and they had learned to deal with these types of behaviors. It is interesting the strategies women used to deal with this situation: some students tended to ignore the situation, while others presented themselves as tough. Evelin stated, for instance,

> You need to have your character, pretend you have a strong character, because if they see that you are like nice, they take advantage, you need to let them know, you need to set a limit, respect. [*Tiene que tener uno su carácter, hacerse de carácter fuerte porque si te ven que eres así bien noble se aprovechan,… tienes que hacerles entender, necesitas marcar un limite de respeto*…] (Eve).

Participants commented that since they spent a lot of time with their male peers, they needed to adapt and make changes in their life styles. In order to fit in, female students even learned to play card games and soccer, activities popular among male students in engineering.

> In engineering, well it is more common to have male friends, a lot of male friends, then your activities change, even the way you speak, and the things you get used to are different, it is all about, not to do what men do, but there is not much for girls [*Ingeniería pues es más común que tengas amigos hombres, muchos amigos hombres, entonces pues las actividades que haces cambian,*

> *incluso tu manera de hablar, y pues las cosas así como que a las que te acostumbras son distintas, como que ya se trata de, no tanto hacer lo que hacen los hombres, pero pues ya tampoco hay tanto de niñas …*] (Caro).
>
> I don't know with my friends… well many times they like to go I don't know to a bar or to the movies, but very few times, they like [more] to go to see wrestling… If we were with more female friends I don't think we would be going [to those places] **-** *Yo, no sé, con mis amigos, pues muchas veces les gusta ir a, no sé, vamos a un bar, o vamos al cine, pero pues muy pocas veces, les gusta ir así como que a las luchas, … pues que no creo que si fuéramos puras amigas, pues no creo que estuviéramos yendo…*] (Yol).

Finally, another strategy the woman students used to gain respect form their male peers was to take what they perceived as a "feminine attitude" in order to state the difference between themselves (female students) and their male classmates. For example, a student explained that she always called her peers by their first name, not by their nicknames or last names, practices that were common among male students. Participants also purposely avoided the rude language that is very common among engineering male students.

Male students' perceptions of their female peers changed over time, and the environment began to feel less hostile. Participants in this study were very proud of the respect they have gained among their male classmates, as Liz explained,

> I deserved it, and they [male students] gave it [respect] to me because I always gain their respect in the classroom with all my classmates. [*Me lo gané y también*

> *ellos me lo dieron porque siempre me di a respetar en el salón de clases con todos mis compañeros*] (Liz).

Participants cited the importance of peer support in their decision to stay, and how they have been able to establish good friendships. They also explained how the best experiences of their student lives included their relationship with classmates. Participants learned to integrate more with their classmates and establish good friendships:

> [Relationships with male students] turn out to be more casual, you are with them all the time, it is like you only are with them [male students] [*[el trato con los compañeros] se vuelve más natural y convives todo el tiempo, como que pues estás solo con ellos*] (Oli).
>
> With my classmates and other engineering students, yes I have good friendships; yes there is respect and a nice friendship [*De hecho todos mis compañeros, no nada más del salón sino de la carrera, este, pues hay un respeto y una amistad muy bonita*] (Liz).

Similarly, participants feel very confident and admired by their male counterparts, as Gaby shared, for instance,

> …my classmates perceived me well, I think like a good student with a lot of qualities to succeed in the future […*mis compañeros me perciben bien, yo creo que en el aspecto de una estudiante buena que tiene muchas capacidades para tener éxito en el futuro*] (Gab).
>
> Furthermore, they feel recognized by their social skills and as good friends,

> Yes they perceived me as optimistic and joyful, yes I'm optimistic [*Si, me perciben como optimista y alegre, si yo soy optimista*] (Ili).
>
> I don't know, in one hand [I'm seen] like another classmate with whom you can study, with whom you can have fun, but at certain point, they [male peers] recognize that I am a good classmate when they need it, I am the girl that listens… [*No sé, como, o sea, por un lado como una compañera más con la que se puede estudiar, con la que se puede echar relajo, pero hasta cierto punto también como que llegan a reconocer que cuado se necesita sí soy compañera, la niña que me va a escuchar*…] (Ama).

Gender roles tended to change over time, the experiences of distrust tended to end, and the roles of female students underwent changes. As the students advanced in the programs, female students began to take more positions of leadership. One participant described how in her work team she is now called "the boss" *[la jefa]* because of the role she plays:

> I don't know if it is my ability but I know how to tell them what to do, "you are going to do this, you that", and they joke "the boss, the boss" *[la jefa, la jefa]*, but finally they do what I tell them, and they let me organize, that's what had happened and I like it." [*Yo no se si sí sea mi habilidad pero se decir, "tu vas a hacer esto, tu aquello" y si se burlan "la jefa, la jefa", pero finalmente hacen lo que yo acordé y me permiten que yo organice... así ha sucedido y me gusta*] (Cla).

Supporting the cultural "macho" values, male students in upper classes tended to protect female students. Noteworthy, it is common among the participants to embrace this attitude of protection given by their peers, as the students shared,

> I feel like now [by the end of the program] the [male] students try to protect us [female students], try to support and take care of us, I feel the environment is good. I like how it has developed *[Yo siento como que ahora los hombres siempre nos tratan de acoger, nos tratan de apoyar y de cuidar y siento bien el ambiente aquí, me gusta como se desarrolla*] (Yol).
>
> … and little by little you get used to it, you make your friends [males] and in a certain way you feel like "protected" [*…y ya poco a poco pues si te vas acoplando, vas haciendo tus amigos y sí de cierta forma te sientes como "protegida"*] (Car).

The quotes illustrate an apparent contradiction of he students' earlier perception where they described the protection given by their male peers as a covered attitude of distrust, and even discrimination. However, by the end of the programs, the students seem to accept the patriarchal culture, embracing the protection of their male peers.

Role of Institutions

Institutional characteristics have been found in literature (Bean, 2005; Tinto, 2005) to affect college student retention. Institutional commitment as identified by Tinto (2005) is a condition for student success. He defined institutional commitments as "the willingness to invest the resources and provide the incentives and rewards needed to

enhance student success" (p. 321). In previous sections, participants described how they attended tutoring sessions for academic support and how the professors helped them stay in their programs. In addition, participants described counseling services, financial support, and prestige of the institution as important for their retention.

The institutions within this study collect quantitative data on retention which they use to determine overall retention patterns and to predict students' needs. Among the most important factors identified by the institutions as important for student retention were high school academic preparation and the selectivity in the admission process. An exam on basic math and science is given to all the students entering engineering colleges in the universities participating in this study. Data generated indicated that students who showed above average academic qualifications on entrance exams were more likely to remain in the colleges.

Some universities, especially public institutions, offer open admission for at least some students, for example those who attended high school in the Mexican University system. Data collected from Mexican University reveal that less than 20% of the students admitted were able to pass the basic math and science exam (UNAM, 2003). In this context, academic support plays a significant role in student retention, especially in the first years. Universities offer remedial courses in math and science for students with low high school academic qualification. The courses are offered in the summer or during the first semester. Besides remedial courses, institutions offer tutoring services that are recognized by the students as very helpful as stated earlier.

In addition to tutoring and remedial courses, counseling services were offered by the institutions. Participants were not very aware of these services, and only one student mentioned going to counseling. She shared: "Yes [it was helpful]… you can tell them what you wanted to, well they listened, they guided you" [*Si, [ayuda]… porque les podías contar lo que tu quisieras, bueno te escuchaban, te orientaban*] (Geo).

Economic support through scholarship and work study was viewed as very helpful and beneficial by the students. In this study, students from both public and private universities recognized the positive role of financial support in their retention. The students in private universities talked about the economic support obtained by their universities through scholarship and work-studies. In all cases, students recognized that it would be very difficult to work during their college years outside the university because of the very demanding academic schedule.

The students in public universities, for example at Mexican University, recognized how the institution provided resources such as books and software to all students, and how this has been very helpful. Evelin reflected on her experience in the following conversation:

> *Evelin-* …In addition, you realized that it is a public university and it gives you many things, like I don't know… At some point you don't realize it but even economically, there are many students [in other universities] that spend more money because they [other institutions] ask them to purchase their own books, and this and that. But not for us, practically with a pencil, paper, and a calculator you can live all college.

Interviewer- What happens when you need books?

Evelin – Well, if [they] ask us for a book, they are in the library, and you can check them out.

Interviewer- Are there enough copies for everyone?

*Evelin***-** Mmh… Yes, there are enough copies…

[*Evelin- …Y aparte que si te das cuenta que a lo mejor es una universidad pública y te da muchas cosas que a lo mejor de repente, no sé, en algún momento que no pensamos bien no lo valoramos y después con el tiempo te vas dando cuenta que incluso hasta económicamente, hay muchos que gastan mucho más dinero porque les piden libros, les piden esto, y nosotros pues no, prácticamente con un lápiz, un papel y una calculadora pues vivimos toda la carrera.*

Interviewer- ¿Y qué hacen con los libros ustedes?

Evelin **-** *Pues nosotros si nos piden libros generalmente están en la Biblioteca entonces hay que ir a sacar los libros*

Interviewer- ¿Y hay copias para todos, o no?

*Evelin***-** *Este… hay suficientes ejemplares*] (Eve).

Mexican University includes students from all socioeconomic backgrounds and supports low-income students by providing them with the resources they need to study. In addition to free tuition and scholarships for living expenses it offers, as it is shown in this quote great support to low income students.

Finally, in this study one of the major findings regarding institutional support is that students from Mexican University expressed that the goal one day being a graduate

of the institution was a great motivator to continue. Mexican University is seen as the best engineering college in the country, and its alumnae include Nobel-prize winners. The students shared their feelings for being part of the institution:

> … to get to school and see "*Ciudad Universitaria*" so big and feel like… a lot of emotion [… *llegar a la escuela y ver la Ciudad Universitaria tan grande y sentir así como mucha emoción*] (Eve).
>
> Yes, and you have that… you are part of the [engineering] college and that gives you prestige; it is like you are recognized, even if they haven't seen your abilities, they recognize you… more because you say you are [a student] from Mexican University. [*Sí y llevar también eso de que eres de la Facultad de Ingeniería también como que te da un prestigio, como que te reconocen, aunque no vean todavía tus habilidades te reconocen nada más por decir que eres [estudiante] de la Universidad*] (Geo).

These students felt that the prestige of the institution played a big role in their retention, and they feel proud being able to be part of the student body and as future alumnae. This pride was only described by Mexican University students

Pride and Motivation for Success

The participants in this study gained a sense of pride and satisfaction for being able to persist in their majors. These feelings encouraged these young women to keep going, to keep focused, and to have confidence in pursuing what they want to accomplish. Engineering is not easy, but they recognize the need to take time away from

family, friends and social life in order to be successful in their programs, and that is part of the pride they have in finishing college. In addition, they have proved to themselves and to others that they can succeed in engineering. The students commented:

> …at the end, you are going to have the satisfaction no? to say "I made it" […*al final vas a tener la satisfacción ¿no? de decir "Sí la hice"*] (Ili).
>
> Yes, … I feel good, not only because you are capable, you aren't a genius or anything but you know you are capable and other girls … it's not that they can't but it is like they don't dare to do it. [*Ay pues sí se siente bonito porque sabes que eres capaz, no es así ser genia ni nada pero sí sabes que eres capaz de más cosas que muchas niñas, no tanto que no puedan sino que no se atrevan*] (Ama).

All the students shared the pride of the family for having an engineering student. One of the students described the pride of his engineering father for having her as the only engineer among his children. In addition to the support and pride, most of the students have a family member in engineering, in many cases the father, but in other cases an uncle or aunt that had shown them the job opportunities engineering has to offer. Ilian shared,

> My aunt, yes because she studied computer science engineering, she works for the university, and she publishes a lot of things, and I see, wow! All what she does sounds very interesting, I read her thesis [dissertation] and I said [to myself] this sounds very interesting. [*Mi tía, si porque ella estudió ingeniería en computación, trabaja en la universidad y este ella pública muchas cosas, y yo*

> *veo ¡órale! todo lo que hace suena muy interesante, leí su tesis y dije si eso suena interesante*] (Ili).

Participants' perceptions of being students in engineering changed during the time they spent in college. At the beginning the students perceived two major challenges: the academic environment, and the fact that they need to live with mostly male students. However, the students learned to live in this environment, as Olivia described,

> …with time I learned to live with them [male students], it turned to be like studying any other thing, except it is lonelier […*con el tiempo me fui adaptando más a convivir con todos, entonces pues siento que es como estudiar cualquier otra cosa, excepto que es un poco más solitaria*] (Oli).

The participants were self-confident in their abilities and they shared that they believed that they can do anything [*ahora siento asi que puedes entrar a cualquier cosa*] (Fer). They felt proud about their achievements as they tend to see difficulties as challenges. The interviewees reported that the obstacles and hardships encountered in their journey made them stronger and confident in their abilities.

> Being an engineering student has helped me. I have more self-confidence now. I am proud to be a junior, almost a senior; imagine if I was able to be here, where else I can be! I want to work overseas; challenges have given me a lot! [*El ser una estudiante de ingeniería me ha ayudado. Ahora tengo mas confianza en mi misma. Estoy muy orgullosa de acabar sexto [semestre] ya casi acabo,*

¡imagínate si fui capaz de llegar hasta aquí a donde mas puedo llegar! Quiero trabajar fuera, los retos me han dado mucho] (Pat).

Furthermore, the college experience broadens the students' initial perceptions of engineering. The students are now aware of the many possibilities engineering has to offer.

I didn't know that many magic things could be done… [*No creí que se pudieran hacer tantas magias…*] (Ama).

…when I see a highway I think of all the work behind it, you learn to see things from many different perspectives […*cuando veo una carretera pienso en todo el trabajo que hay detrás; aprendes a ver las cosas desde muchas perspectivas distintas*] (Eve).

A strong desire for achievement was an important component of the female student motivation to complete college. Students felt that as they started something they do not want to leave it unfinished "and the mentality is that if I start to do something, well I start it to finish it and finish it well" [… *y pues es la mentalidad es que si yo entro a hacer algo pues entro a terminarlo y a terminarlo bien*] (Gab).

Student motivation comes also from the hardship and obstacles they found. They believed that their personal character was very important in their persistence, one student shared,

… we [female engineering students] are stubborn, when people say "no, you can't do that", it is like I want them to see that I can […*[las mujeres que*

> *estudiamos ingeniería] somos necias, que cuando la gente dice "No, es que no lo puedes hacer tu", pues me dan mas ganas de que vean que si puedo*] (Yol).

Personal interest plays an important role in the persistence of women students in engineering. They all liked engineering very much and the challenges the college presented were sorted by the strong desire to be part of engineering and they see that finishing college was what they really wanted.

> I really want to be an engineer [*Yo verdaderamente quiero ser ingeniera*] (Eve).
>
> The commitment first, is with myself, with my preparation, and because I really like my major I can not leave it [*…el compromiso primero que nada es conmigo, con mi preparación y porque me encanta mi carrera, no la puedo dejar*] (Liz).

In addition, some of the students that decided to study industrial or computer science engineering because there were more women in the programs; at the end of their programs, when they reflected on their experiences, they explained that if they had to decide today they would choose mechanical or civil engineering, which are programs with less woman participation; these participants felt that they have learned to live in the environment and that they could do it, "It doesn't matter that there were just men" [*no importa que hubiera puros hombres*] (Ili).

Participants enjoyed their major, and all of them would decide if they had the chance, for engineering again:

> Absolutely, I'll choose engineering again. No other option seems more appropriate right now. [*Absolutamente, escogería ingeniería otra vez. Ninguna opción suena mas apropiada ahorita*] (Mar).

> Yes, I'll choose engineering again, any engineering. I like my major very much; yes I'll pick the same. [*Si, escogería ingeniería otra vez, cualquier ingeniería. Me gusta mucho mi carrera y si escogería lo mismo*] (Ana).
>
> I have learned a lot, the idea of yourself takes force, you have self-esteem, and you are proud of yourself. [*He aprendido mucho, la idea de ti misma toma fuerza, tienes amor propio y estás orgullosa de ti misma*] (Luc).

Most of the students are passionate about engineering and they plan to continue with their occupational goals. Most of the students would like to work for one or two years before going to graduate school, or find a part time job that they will combine with school. One student wants to be a professor, so her plans go over a PhD, she wants to be a researcher. They all see themselves as professional engineers.

In this chapter I reported the findings of this study. The participants described the different manifestations of the masculine culture present in the Mexican society. Participants identified how Mexican society has conceptualized gender roles and how this conceptualization has lead to stereotypes of women students in engineering colleges. The masculine culture influences the engineering college environment, which participants described as challenging. This challenge has two dimensions: academic and social. There is a dual role faculty and peers played in the retention of the female students. On the one hand, participants described situations where hostility came form faculty and peers, and on the other hand, they also cited the importance of faculty and peer support in their retention. Except for one university, the students did not perceive the role of their institutions as very strong in their retention. All the participants were

proud that they persisted in their programs and they perceived themselves as capable of accomplishing whatever they wanted their lives.

CHAPTER V

DISCUSSION, RECOMMENDATIONS, AND CONCLUSIONS

Summary

The purpose of this study was to identify why female students remain in engineering colleges in Mexico. The study sought to understand and describe the perceptions of women engineering students in Mexico regarding the personal, institutional, and cultural characteristics that help them persist in their programs. To address this concern a qualitative method of inquiry was used.

This dissertation is set in a particular social context where, although females have increasingly entered the labor market, and the proportion of women in college has achieved parity with men, in some college programs such as engineering the proportion of males is still far greater than females. A review of the literature reveals the efforts of higher education institutions and woman-focused programs to increase the recruitment of young women into engineering by strengthening their academic abilities and by helping them challenge the cultural barriers associated with the male stereotype of engineering programs. In addition, research that has examined at the experiences of female students in engineering colleges has mainly focused on the challenges they face and why they leave, and has not explored why some female students persist despite these challenges. Thus, little research has focused on the strategies female students develop to be successful in the strongly male oriented environments that comprise colleges of

engineering. My dissertation research makes contributions within this context, as it describes the experiences of female students in Mexican engineering colleges who have persisted in their programs.

To collect data I selected 20 participants from four Mexican institutions of higher education. The sample of the institutions was purposively selected based on several criteria: public and private universities, socioeconomic level, size, geographic location, and accessibility to the researcher. I visited these institutions over two trips to Mexico during 2007. To gather information I used interviews and observations, and I also collected documents. I conducted semi-structured interviews using an interview guide that was revised as the research progressed. I conducted the first interviews over the Internet, using Skype; after reviewing those interviews, I went to Mexico to continue with the remaining interviews. I asked questions regarding participants' experiences in college; I also gathered demographic information including year and program the students were in, number of siblings and their level of education, parents' education, GPAs, and information about their high schools. In addition to interviews, to help me better understand the context and interpret the data, I conducted observations of students' day-to-day activities such as classes, lab work, and visits with professors. Finally, I reviewed and analyzed documents when I visited the campuses and through the Internet. These documents included university mission statements, histories of the universities, and enrollment and attrition data.

As a result of the analysis I identified themes and categories that helped me answer my research questions and provide suggestions for future research. The first

finding focuses on how female Mexican engineering students faced significant cultural stereotypical attitudes about gender roles and expectations, and how they were constantly negotiating between rejecting traditional gender roles and upholding the norms. The women in this study confronted these broader cultural stereotypes but also more specific stereotypes of female engineering students, which view female students as less capable than men, unsocial, and physically unattractive. As a result, the students associated beauty with superficiality, lack of intelligence and commitment. Second, findings revealed the academic and social challenges female engineering students experienced in college. Participants in this study embraced these challenges as they saw them as obstacles to overcome. They shared how they were able to persist in their programs through academic support in the form of tutoring, and to dissociate gender from engineering ability by sharing beliefs that abilities needed to succeed in engineering programs can be developed by working hard. Participants also focused on proving that they could do the work and on showing an image of good students in order to demonstrate to themselves and to others that they belonged into the program. Third, findings indicated that relationships with faculty and peers have two sides—on the one hand, participants experienced gender discrimination from some peers and some faculty; on the other hand, participants identified professors and peers as very important for their retention. Finally, the last finding that emerged is that female students' persistence in engineering programs gave them a sense of pride and self-confidence that is shared by their families, peers, and professors.

Based on these findings, there are three important issues I will highlight in what follows: (1) the role of cultural values in retention; (2) the ways in which participants perceived difficulties and obstacles as *challenges*, which resulted in female students feeling more self-assertive and self confident; and (3) how female students "become successful" and "accepted into the club" and reproduce the value system.

Discussion

Cultural Values and Retention

In this section I discuss the role of Mexican culture, its influence on the culture of engineering colleges, and its role in the persistence of participants in this study.

A significant finding of my study was the role Mexican culture played in the student experience of the participants. This masculine culture manifests in the cultural and family values that associate the female gender with inferiority and perceive women as caregivers, mothers, and mainly responsible for the house. Participants in this study describe the pressure they experienced to conform to these traditional roles because in contrast with their parents, their own perceptions of gender roles differ substantially from society's, as they expect more equity and view themselves as professional engineers.

Family support is documented in the literature as very important for the retention of minority students in college; this literature specifically focuses on how parents provide positive encouragement for their children, which helps with retention. Goodman and Cunningham (2002) reveal that young women in engineering consider their parents

to be the most encouraging people in their lives, both before and during college. Gándara's (1995) research on Chicana women in higher education reports similar findings. Data from my own study confirms this literature, as all participants were part of families who encouraged their educational attainment, and participants discussed the important role their families played in their persistence in college, not only supporting them economically, but also encouraging them to be happy and to pursue their dreams.

Other research on the role of parental influence on the retention of college students (Bean, 2005; Carpenter & Fleishman, 1987; Hossler & Stage, 1992) focuses on parental education and socioeconomic background as factors that influence the amount of encouragement students receive in college and the ways students interact with the institution. In general, this research has found that college educated parents provide more encouragement, and provide more social and cultural capital to students than parents without college degrees; this capital increases students' positive interactions with their institutions and thus leads to higher retention rates (Bean, 2005). In my study, however, all the parents of participants provided strong encouragement, regardless of their socioeconomic and professional backgrounds—some of the parents were college educated but some participants were first generation students.

Research describes the strong relationships between Latina academic achievement and their mothers' support and encouragement of educational goals (Gándara, 1995); female students in this research likewise mentioned their mothers as very supportive, not only because they encouraged their daughters, but because of all the help they gave to their daughters. Two participants who were mothers themselves relied

on their own mothers or mothers-in-law to take care of their children while they were in school. Participants in my study seemed to have a dual position. On the one hand, most of them are still residing with their families and are benefiting from their mothers' traditional roles. On the other hand, my findings suggest that participants resist taking on traditional female roles themselves even though they benefit from their mothers' enactments of that role. This situation seems to be part of the lives of female engineering students, where context played a role as they embrace the cultural values if these values can help them succeed.

Literature on college student retention argues that females have better persistence and retention rates than males in higher education and discusses the need to recognize the culture of students to understand their ability to negotiate the institutional culture of higher education (Astin & Oseguera, 2005; Mortenson, 2005; Nora, Barlow & Crisp, 2005). Similarly, women's learning has been examined in the literature and has reinforced women success in higher education. Research and theory about women as learners stresses the significant role of relationships in women's lives and highlights women's preferences for "connected knowing." This literature often characterizes women as subjective, intuitive, and emotional, and even includes brain studies that look for biological differences between women and men (Baxter Magolda, 1992; Belenky et al., 1997; Flannery & Hayes, 2002; Gilligan, 1982). In addition, research (Crawford, 1995) has explored the social dimensions of learning, arguing that learning is related to the context in which it occurs, creating different behavior expectations for people of different genders.

Overgeneralizations and assumptions about women have permeated colleges of engineering where women deal with the possibility that their performance might confirm the stereotype of women's low aptitude for math and science. These perceptions led participants to feel social pressure and caused them to work hard against the discrimination they experienced and the cultural constraints at work within the college, through focusing on proving they can do the work and by obtaining good grades. Participants used this strategy of proving to themselves and to others that they can succeed to resist the cultural pressures that push many women away from engineering, even though this strategy has serious limitations because women feel the pressure to always look smart. In addition, findings showed how female students navigate through a system of male privilege that is dependent on social and cultural factors. Female students recognized popular beliefs about women's inferiority in science, and tried to break these stereotypes and engage in engineering, in order to challenge existing power and become active agents in defying the cultural values.

Similarly, female engineering students in Mexico must deal with the stereotype of being perceived as unfeminine, nerds, and the least attractive students across any university campus. These stereotypes are rooted in Mexican cultural values and social constructions of gender that stress engineering as masculine and that consequently position female students in engineering as unfeminine. Westman (2007) discusses how society "has traditionally assumed that geeks are male, with the result that a female geek betrays' society's gendered expectations" (p.11). Participants described strategies that protect themselves from these pervasive cultural stereotypes. For example, female

students stressed the value of intelligence over beauty, associated beauty with superficiality, argued that their busy academic schedule does not allow them time for their personal look and furthermore, supporting Waller's (2004) findings, students shared a belief that spending time on appearance indicates less commitment to academics.

However, there is an interesting tension between the culture of engineering and the Mexican culture. On one hand female students learn to navigate in the engineering environment where they are seen as unattractive by denying the value of beauty, while on the other hand participants seemed to experience pressure to conform to cultural stereotypes that relates femininity with beauty, and more recently portraits by media of successful professional women as pretty (Westman, 2007). Waller's (2004) research about women's self presentation suggests that how female students in engineering present themselves reflects cultural norms and their agency to accomplish particular goals or to reject societal expectations. Data from my study suggest that female students struggle to negotiate the link between being an engineer and appearance. Participants seem to embrace the engineering culture and prove they belong into the field by not paying attention to their personal appearance, while at the same time they embrace the contradictory cultural value that associates femininity with beauty, sharing that they all view themselves as pretty and they like to "dress-up" when they go out, specifically to challenge the "nerdy and ugly" stereotype by showing themselves as both pretty and engineers.

Turning Difficulties into Obstacles to Overcome

Literature on college student retention states that students who do not feel welcome into a culture are less likely to stay in college (Bean, 2005; Tinto, 1993). However, although they are aware of how Mexican culture has discouraged women from entering and succeeding in engineering professions, participants in this study decided to enroll in the programs, to persist, and to become active agents to change the culture.

In addition to social and cultural values present in Mexican society, there is a culture in engineering colleges that influenced the experiences of participants in this study. Participants shared many difficulties and challenges they experienced in college. It is noteworthy how female engineers dealt with the difficulties they encountered, and how they interpreted the meanings of those difficulties. Participants found college very challenging academically. Of particular interest is that, in contrast with the literature that states that conceptual difficulty is one of the most discouraging factors in pursuing an engineering degree (Duncan & Zeng, 2005; Goodman & Cunningham, 2002), participants in this study stated that they actually *enjoyed* the academic challenge; their decision to study engineering was, in fact, *bolstered* by their self-perceived strength in and confidence to handle difficult subjects in high school, and by their desire to pursue a college major that was intellectually challenging.

Moreover, findings also suggest that female students see themselves as academically strong and possessing all the intellectual abilities they need to succeed in their engineering programs. Bean (2005) defines self-efficacy as students' beliefs in their abilities to survive and adapt to the academic environment. He states that students who

believe they can achieve their goals increase their self-confidence and can increase retention. Similarly, Dweck's studies on motivation examine the role of self-conceptions in motivations and self-regulation, and their impact on achievement. (Dweck, 2006; Grant & Dweck, 2003). These studies describe how female students who view intellectual ability as a quality that can be developed and not as a gift seek effective solutions in the face of difficulties, maintain their interest in learning, and are less susceptible to stereotypes. In the challenging engineering environment, participants looked for support and were able to develop the abilities needed to succeed in their programs. Noteworthy, all participants agreed that abilities can be developed, and they valued hard work over natural ability. They associated hard work with persistence in school, and, congruent with the literature, they developed self-confidence as they succeeded in their programs. For these students, like for Gándara's (1995) participants, hard work translates into persistence, and they use this quality as a means of self-assertion and to overcome the cultural stereotypes they face.

Furthermore, among the challenges the students experience in college is gender discrimination coming from some peers and some faculty. Bean (2005) discussed how discrimination against students for any reason such as class, race, sexual orientation, or gender will lead students to feel that they do not belong or do not fit in the institution, an attitude that is closely related to the intent to leave or to stay. However, my findings suggest quite the opposite. Participants in this study saw academic success as a motivating force to overcome or diminish the impact of discrimination and to affirm themselves. In both cases, findings suggest that female students see themselves as

potential actors. They revealed that they possess an internal locus of control (Bean, 2005), as they stressed the value of persistence over natural ability, and, particularly, disassociated ability with gender. Furthermore, they saw themselves as actors rather than victims, to overcome discrimination. Bean (2005) discusses how internal locus of control ultimately leads to student retention.

Tinto (2005) discusses social interaction as one of the main pillars in college student retention. Many studies focusing on diverse settings and students have confirmed that the more students engage with faculty, staff, and their peers, the more likely they will persist in college (Astin & Oseguera, 2005; Bean, 2005; Mortenson, 2005). It is important to note that participants in this study perceived the engineering environment as individualistic and they experienced isolation. Furthermore, literature describes the environment in engineering as not very social (Allen, 1999; Goodman & Cunningham, 2002; Tobias, 2000). In addition, cultural values reinforce this perception, as engineering students are perceived as nerds and not very social. Although social pressure has been documented in the literature as a cause for girls and women to lose interest in science and math (Sadker & Sadker, 1994; Westman, 2007), participants in this study learned to live in this environment and even reframed the environment into a challenge to overcome. To engage in engineering, participants learned to negotiate culturally accepted expectations of “feminine” behaviors, and findings suggest that once in engineering, participants adapted their behaviors to conform to the masculine culture. It is noteworthy, that congruent with literature (Astin, 1993; Bean, 2005; Seidman, 2005) although participants lived in a male oriented environment, they valued peer

relationships, as they described the friendships and the good work teams they found in college as one of the most important factors in their persistence.

Literature on women's learning (Belenky et al., 1997) suggests that women's preferences are for learning that is cooperative, and studies on women in engineering (Duncan & Zeng, 2005; Goodman & Cunningham, 2002) indicate that a competitive climate has contributed to the attrition of women students in engineering. In addition, cultural values associate femininity with care giving and cooperation. In contrast to this literature, although most participants in this study valued group work and cooperative learning, and shared how peer support was very important for their retention, findings also suggest that many of the participants like competition. Moreover, literature on female attrition in science and engineering (Lipson & Tobias, 1991; Rosser, 1993) suggests that faculty promote the elitist idea that engineering is academically very difficult and not for everyone, and expect students to prove themselves. Findings of my study suggest that participants use competition as a way to prove to themselves and to others, especially professors, that they are good students and equally capable than men, and reinforce their belonginess to the field.

Findings of this study illustrate how participants learned to see the hardships and obstacles they experienced as challenges, how they negotiated the cultural expectations of females in Mexico, and how they use resistant strategies like academic success to become accepted in the male-dominated engineering environment.

Welcome to the Club

Engineering is a male-dominated profession and this is reflected both demographically and culturally in engineering colleges, which have only small percentages of female students and where gendered stereotypes about women abound. Findings suggest that female students learned to live in this male-oriented environment while at the same time they chose to be agents for social change. Participants discussed how they were able to find sources of support to stay in their programs in their institutions, namely their professors, peers, and families; in addition, many of the characteristics of perseverance are personality traits. Moreover, the fact that participants were able to persist in their majors gave them a sense of pride and satisfaction. Although this pride started when they were good students in high school and were admitted to the programs, most of the students experienced doubts about their belonging in the engineering environment. However, these doubts disappeared and their pride was reinforced as they advanced in their programs and as they experienced more acceptance from peers and faculty. This pride was shared by the students' families, who were very proud to have a female student in engineering.

Tierney (1990) describes how different academic disciplines and specialties have values that embody the behaviors and beliefs that offer professional status. Engineering has an elitist notion of superiority, and my findings suggest that engineering students, professors and administrators in engineering colleges in Mexico share a belief that other majors are easier and not as valuable as engineering. In this environment, female students constantly found themselves trying to earn the respect of faculty and peers.

Professors, congruent with the literature, were identified by students as the most influential group in the institutional context that affected their retention. Astin (1993) mentions the role that student-faculty interactions play in motivating students to maximize their chances for success; similarly, Bean(2005) argues that faculty members can reinforce or challenge students' self-image; and finally Duncan and Zeng's (2005) research on the persistence of female students in engineering suggests that faculty support and good teaching were very important factors in student retention. Participants in my study described how some professors were very supportive and encouraged female students to broaden their engineering views. As they advanced in their programs, discrimination eased and students felt recognized by their professors as good students, capable and responsible. Literature states that professors in science and engineering expect good students to "rise to the top" and to have "intrinsic interest in the subject matter" (Tobias, 1990, p.10). Findings suggest that female students seem to embrace these expectations and the elitist culture by proving themselves as good students in order to be accepted by their professors.

In addition, participants shared how with good female professors the environment in the classroom is less hostile and how these professors, congruent with literature (Duncan & Zeng, 2005), were successful female role models for them and a strong factor in their persistence. However, they also shared how female professors were more demanding and strict academically, thus reproducing the elitist "academically challenging" and "not for everyone" culture of engineering.

Similarly, peer support, congruent with the literature, was cited as important for the participants in their decision to stay. Peers support is found in the literature as important for women retention in engineering, not only because peers assist them in their class work, but also because the work-teams tend to develop good friendships that turn into personal and social support (Clark et al., 2003; Duncan & Zeng, 2005). Gender roles changed over time, and female students begin to be perceived by their male peers as more capable, good students and good friends. As with professors, participants felt that they were able to gain respect from their male peers by proving to themselves and to others that they are good students and good friends.

It is noteworthy that participants perceived that as part of the Mexican culture of "macho" attitudes, male students tended to protect their female classmates. At the beginning of their programs, these attitudes were seen by the participants with distrust and as subtly disguised discrimination; however, as students advanced in their programs, they experienced a change in their perceptions and began embracing the protection, support and care given by their male peers. Female students in engineering in Mexico ended up embracing the masculine and elitist culture of engineering. Although they rejected cultural and gender stereotypes and power relationships, they also seemed to conform and maintain cultural characteristics like the protection they experienced from their male peers.

Success in engineering as perceived by the participants is dependent on a variety of factors. Participants in this study described a journey where character, interest, and engagement are required. The pride experienced by these students for persisting in the

college reinforces the elitist culture of engineering. Peers and professors at the end of the programs also shared the pride and included the female students in the elitist environment of superiority. Ultimately, the students in this study ended up both resisting and reinforcing Mexican cultural stereotypes as well as the masculine, elitist culture of engineering colleges.

Recommendations for Research and Practice

Local contexts shape the culture of universities. Furthermore, individual institutional values and assumptions are inherent to institutions. These values are a result of the history, size, socioeconomic population they serve, and type of institution: public or private, religious or secular. However, results of this study indicate that female students in engineering in the programs and institutions selected do share many of the same experiences in college. In addition, they identified sources of support and strategies that helped them persist in their programs.

However, contextual differences may influence the experiences of female students in engineering. This research can be replicated as a comparison and contrast study that considers the differences between public and private institutions. The study must consider public and private Mexican universities that are similar and thus comparable in characteristics such as size, socioeconomic background of students, prestige, and geographic location.

My findings might have been different if I had investigated programs such as biochemical, chemical, and environmental engineering. Although these programs are not

always part of engineering colleges in Mexican universities, but are sometimes included in colleges of science, they have proven to have similar academic challenges and female enrollment is more than 40% (Jaime & Tinoco López, 2005). A study could be conducted to identify why these engineering programs have been more successful in attracting and retaining female students.

Another direction for future research points towards female engineers' professional practice. Research on professional women in Mexico implies that women engineers still face a hostile environment in the work place (Bustos 2003; García Guevara, 2002a). An extension of my dissertation research could be a prolonged engagement, longitudinal approach with an analysis after a period of time regarding the experiences of the participants in the workplace to better understand the role of the culture in the life of professional women engineers, and how the experiences in college prepared them for the work place.

Findings of my study suggest the important role that culture plays in the retention of Mexican female engineering students. Further research might identify the experiences of female engineering students in other countries and cultures analyzing differences and similarities. Of particular interest might be to compare the experiences of Mexican female students with Indian students because this country has a higher participation of females in engineering programs than Mexico and the U.S. (Sukumaran, Hartman & Johnson, 2004). Similarly, a comparative study could be conducted with students in Mexico and Mexican-American students in the United States. The purpose for that study would be to help better understand the role of Latino culture in retention.

Tinto (2005) argues that despite all of the research on student retention, there is a failure to include the findings of this vast body of research to guide institutional action and thus to turn the results into practice. Mexican institutions have had the same experiences; data from engineering colleges participating in this study reveal that there has not been an improvement in the retention of engineering students in the last four years. Furthermore, findings indicate a problem with the climate of engineering education; the culture and climate of engineering is not welcoming for women. Female engineering students in Mexico face significant cultural stereotypes, and participants in this study, although they shared positive experiences, also recall negative experiences in college. As Muller (2003) states, "societal beliefs, attitudes, and behaviors still lead to differential perceptions and expectations for women" (p.3). If institutions wish to retain their female students, they need to understand the culture of engineering colleges and prepare for the anticipated resistance by students, faculty, and administrators in order to change the behavior in the organizations.

Moreover, if institutions seek to understand the causes of attrition and retention, they need to better account for and understand why there are high rates of attrition in engineering. Hagedorn (2005) discussed the complexity of measuring college student retention. Most institutions provide statistics regarding the number of students that are enrolled in engineering programs each year and compare the final graduation numbers. However, these statistics do not provide information about which students leave, their GPA, gender, or their causes for leaving college. In addition, some students re-enroll in the same year or enroll in a different program or institution. It is unclear how these

students are considered by each institution. Furthermore, Hagedorn (2005) states that retention and drop out are used as dichotomous measures in education; however "drop-out" is one of the most frequently misused terms in higher education, and the term does not capture the complexity of college attrition, or even of students' educational goals. Institutions need to better document students' attrition.

Faculty and administrators need to be aware of the important role they play in retention. Participants in this study stated that faculty members, congruent with the literature, were among the most important source of encouragement and critical to student educational attainment. In addition, faculty was also cited by participants and in the literature as a source of discouragement (Duncan & Zeng, 2005; Goodman & Cunningham, 2002). An initial step to help female students persist in engineering is to help faculty be aware of the great influence they can have on student success (McKeachie, 2002). Similarly Bean (2005) discussed how the way in which administrative activities are carried out can lead to social integration and a better identification with the institution, which in the end affects retention. Retention goals and the importance of faculty and administrator roles could be communicated through various workshops.

Goodman and Cunningham (2002), in their study of undergraduate women's experiences and persistence in engineering majors, suggested that the availability of formal or informal support programs for women have a positive impact on retention. Female students need to be aware of the opportunities that institutions offer. Support programs for women were available in many of the institutions of the participants in this

study; however, students did not mention taking advantage of or using that support. Therefore, the institution and associations need to improve the promotion of their services to the students and conduct better outreach activities.

Learning communities have been discussed in the literature as important for college student retention because they provide a structure of collaboration between students and faculty and between students as they spend more time together and tend to develop support groups (Taylor, Moore, MacGregor & Lindblad, 2004; Tinto, 2005). Learning communities are part of many engineering programs in the U.S.. Some universities in Mexico, especially private universities, have cohorts for first year students, which can allow creating different communities. Although cohorts are not necessarily learning communities, they can be a first step towards creating them. Students connect with each other and are encouraged to work in teams. However, universities need to be more intentional in developing learning communities and should consider not only academic differences and programs, but also gender and socioeconomic class. Learning communities have proven to offer an effective way of addressing a variety of learning needs, and can allow institutions to support learning and retention (Tinto, 2005).

Similarly, mentoring programs have proven to positively affect retention in science and engineering programs particularly helping boost women's confidence in their abilities (MentorNet, 2002). Participants in this study stated that self-confidence was a major factor in their persistence. Programs like MentorNet (Muller, 2003) in the U.S. provide one-on-one, email-based mentoring relationships with mentors from

industry, government, and higher education. Similar programs could be implemented in Mexico and could give support and direction to female students in engineering programs.

When considering the under-representation of women in engineering, institutions, faculty, and administrators need to be careful about over-generalization and assumptions of gender differences. Cultural values still lead to perceptions and expectations of female behaviors and attitudes that can affect learning, and theories about women's learning see women as collaborative, relationship-oriented, subjective, intuitive, and emotional (Belenky et al., 1997; Crawford, 1995; Miller, 1986). However, as Muller (2003) states, "men and women are more alike than they are different" (p. 3). An orientation toward personal development with good educational practices, focusing on the learning of all students, can help challenge social beliefs and stereotypes, and can benefit the learning of all students.

Conclusion

The experiences of the students in my study offer engineering colleges challenges and opportunities. Retention of female engineering students is important for all engineering colleges, but cultural factors must be taken into consideration. The dominance of machismo attitudes and values in Mexican culture present specific challenges to achieve an environment more supportive of women in Mexican engineering colleges. This study lends important insights into how this might be achieved. Participants in this study were conscious about the culture of engineering well

before they entered college; however, they chose to engage and take the chance. Institutions need to be proactive and creative in order to help faculty and administrators provide an environment in which female engineering students can be successful. A change of culture, as stated by Godfrey (2007), is not an easy process, and it requires not only a change of behaviors and practices, but also the encouragement of practitioners to shift values and cultural norms. By better understanding the culture, researchers can anticipate resistance and propose more effective and implementable changes. This study is a first step to try to understand the role of the culture in female engineering education in Mexico.

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APPENDIX A

INVITATION LETTER[2]
(UNIVERSITY)

<<Date>>
<<First>> <<Last>>
President <<Higher Education Institution>>
<<Address>>
<<City>>, <<St>> << Zip>>
Dear <<First>> <<Last>>:

I am contacting you from Texas A&M University as a part of my doctoral dissertation research. I am conducting a study in which I am interested in interviewing female engineering students in Mexican Higher Education Institutions. The tentative title of my dissertation topic is: The impact of students' life experiences on program retention as reported by female students in selected engineering colleges in Mexico.

Because educational trends and initiatives are different among countries, it is not surprising that Mexico will present specific needs dictated by its cultural reality and specific criteria like kind and size of institutions and type of engineering programs. The purpose of this study is to identify why female students remain in engineering programs in Mexico.

Approximately fifteen to twenty female students in engineering colleges in Mexico will be involved in this study. During the sampling process, your institution has been selected. I would like to visit with your and have the opportunity of interviewing some female engineering students. The interviews will last about one to one and a half hours. In addition to the interviews, I would like to observe some of the students during a regular day at your institution

Before meeting with you and conducting the interviews, I will first call you in order to obtain the names of female engineering students who you think would like to participate in this study and are at least in their junior year. If you have any questions about this study, please feel free to contact me at (979) 845-1561 or cgvilla@neo.tamu.edu, or my chair Dr. Jennifer Sandlin at (979) 458-0508 or jsandlin@coe.tamu.edu.

Thank you for your time and assistance in advance. I am looking forward to meeting you.
Sincerely,

Carmen G. Villa
Principal Investigator
Texas A&M University

---

[2] González y González (2004)

CARTA DE INVITACION
(UNIVERSIDAD)

<<Nombre>> <<Apellidos>>
Ejecutivo <<Institución de Educación Superior>>
<<Dirección>>
<<Ciudad>>, <<Calle>> <<Código Postal>>
Estimado <<Nombre>> <<Apellidos>>:

Aprovecho para enviarle un cordial saludo, permítame presentarme, mi nombre es Carmen García de Villa, soy Candidata a Doctor y como parte de mi investigación doctoral lo estoy contactando desde la Universidad de Texas A&M. Actualmente, me encuentro conduciendo un estudio en el cual estoy interesada en entrevistar alumnas de ingeniería en instituciones de educación superior en México. El título tentativo de mi tema de investigación es: El impacto de las experiencias de la vida estudiantil en la retención descrito por alumnas en escuelas y facultades de ingeniería en México.

Debido a que las tendencias e iniciativas educacionales son diferentes entre los países, no es sorprendente que México presentará necesidades específicas dictadas por su realidad cultural y criterios institucionales específicos entres los que se incluyen tipo y tamaño de la institución y el tipo de ingeniería seleccionada por las estudiantes. El propósito de este estudio es identificar porque las alumnas permanecen en las carreras de ingenierías en instituciones mexicanas.

Aproximadamente quine a veinte alumnas serán incluidas en este estudio. Durante el proceso de muestreo, su institución ha sido seleccionada. Me gustaría poder visitarlo y tener la oportunidad de entrevistar, si usted esta de acuerdo, a algunas alumnas de ingeniería de su institución. Las entrevistas duraran entre una hora y una hora y media. Además me gustaría poder observar a algunas alumnas durante un día regular de clase.

Antes de visitarlo y conducir las entrevistas, yo me pondría en contacto con usted para obtener el nombre de las alumnas que usted considere quisieran participar en el estudio. Las alumnas deberán estar cursando al menos el tercer año del programa. Si surgiera alguna pregunta acerca de este estudio, por favor siéntase en la libertad de contactarme al teléfono (979) 845-1561 o bien puede enviarme un correo electrónico a cgvilla@neo.tamu.edu. También puede contactar a mi asesora, la Dra. Jennifer Sandlin al teléfono (979) 458-0508 o en la dirección de correo electrónico jsandlin@coe.tamu.edu.

Gracias de antemano por su tiempo y su apoyo en la realización de este estudio. En espera de poder visitarlo queda de Usted su segura servidora.

Atentamente,

Carmen García de Villa
Investigadora Principal
Texas A&M University

APPENDIX B

Interview questions

Descriptives.

Date _____
Institution _____
University _____
Type (public/ private, size) _____
Type of eng _____
Parents ed level _____
Siblings ed levels _____

GPA
High School
GPA _____
preparation (good, bad, medium)_____
strengths _____

Semi-structured questions.

1. When did you decide to become an engineer and how certain were you to choose your major?
2. What factors influenced your decision?
3. How certain were you about your decision?
4. What was your family opinion?
5. Can you describe your experiences in the engineering classroom?
6. Can you describe your experiences outside the engineering classroom?
7. Do you feel competent in the classroom?
8. What kind of academic competencies do you need to survive in engineering?
9. What kind of social competencies do you need to survive in engineering?
10. Other abilities or competencies that you need?
11. How are you perceived by your professors?
12. How are you treated by your professors?
13. How are you perceived by yourclassmates?
14. How are you treated by yourclassmates?
15. How is it to be woman in a non-traditional field?
16. Do you think your student life is different from female students in other majors?

17. What are the challenges you have needed to face in the eng. environment?
18. Positive experience
19. Negative experience
20. How did you "survive"? What keeps you going?
21. What is the role of … in your persistence? Where do you find support?
    a. Institution
    b. Faculty
    c. Advisors
    d. Other students
    e. Family
    f. Other
22. Do you think your vision of engineering has change since you started college? If yes, how has it changed?
23. Tell me about your personal beliefs about men and women and their respective roles in the home and workplace?
24. Are these beliefs different from your parents'?
25. What would you tell a young woman entering engineering? (advice)
26. If you have the opportunity, will you choose engineering again? Why?
27. Do you think the experiences of female students in engineering are different in other countries? If so, how are they different?
28. Do you think the socio-ecnomic level of students play a role in retention? If yes, how?
29. Do you think the physical appeareance of students play a role in retention? If yes, how?
30. What are your future plans?

Guía de entrevistas

Descriptivas.

Fecha _____
Institución _____
Universidad _____
Tipo (pública/ privada, tamaño) _____
Tipo de ingeniería. _____
Nivel educativo de los padres _____
de los hermanos _____
Promedio Preparatoria
promedio _____
preparación (bueno, malo, regular) _____
fortalezas _____

Preguntas.

1. ¿Cuándo decidiste estudiar ingeniería y qué tan segura estabas de esa carrera?
2. ¿Qué dirías que fue lo que mas influyo en tu decisión?
3. ¿Qué tan segura estabas de tu elección?
4. ¿Qué decía tu familia?
5. ¿Puedes describir tus experiencias en el salón de clase?
6. ¿Puedes describir tus experiencias fuera del salón de clases?
7. ¿Te sientes capaz/ competente en el salón de clase?
8. ¿Qué habilidades académicas necesitas para "sobrevivir" en la escuela de ingeniería?
9. ¿Qué habilidades sociales necesitas para "sobrevivir" en la escuela de ingeniería?
10. ¿Hay otras habilidades que necesitas?
11. ¿Cómo te perciben los profesores?
12. ¿Cómo te tratan los profesores?
13. ¿Cómo te perciben los compañeros y compañeras de clase?
14. ¿Cómo te tratan los compañeros y compañeras de clase?
15. ¿Qué se siente ser mujer en un campo "no- tradicional" para mujeres?
16. ¿Tú crees que tus experiencias son diferentes a las de otras chicas estudiando otras carreras "más tradicionales?
17. ¿Cuáles son los retos/ barreras que has tenido que enfrentar en la escuela de ingeniería?

18. Experiencia positiva
19. Experiencia negativa
20. ¿Qué te hizo seguir adelante? ¿Cómo sobreviviste?
21. ¿Cuál es el rol que juegan en tu persistencia? ¿Dónde encontraste apoyo?
    a. Institución
    b. Profesores
    c. Asesores
    d. Compañeros de clase
    e. Familia
    f. Otros
22. ¿Crees que tu visión de ingeniería ha cambiado desde que empezaste la Universidad? Si sí, ¿cómo cambió?
23. ¿Cuál crees que es el rol de las mujeres y el de los hombres en la casa y en el trabajo?
24. ¿Qué opinan tus papas al respecto?
25. ¿Qué consejo le darías a una estudiante de prepa que esta decidiendo estudiar ingeniería? ¿O qué esta empezando ingeniería?
26. Si tuvieras oportunidad de volver el tiempo atrás, ¿escogerías ingeniería otra vez? ¿Porque?
27. Otros países, ¿cómo crees que son las experiencias de las mujeres estudiando ingeniería en otros países?
28. ¿Tú crees que el nivel socio-económico juega un rol en la permanencia de las alumnas en la escuela de ingeniería? ¿Si sí, cuál es ese rol?
29. ¿Tú crees que la apariencia juega un rol en la vida estudiantil de las alumnas en la escuela de ingeniería? ¿Si sí, cuál es ese rol?
30 ¿Qué planes tienes para el futuro?

APPENDIX C

INFORMATION SHEET

The impact of students' life experiences in program retention as reported by female students in selected engineering colleges in Mexico. (Tentative title)

You have been asked to participate in a research study about women in engineering programs in Mexico. You were selected to be a possible participant because you are in your junior or senior year in an engineering college in Mexico. A total of 15-20 female students have been asked to participate in this study. The purpose of the study is to identify why women remain in their engineering programs in Mexico.

If you agree to be in this study, you will be asked to have an interview sharing your student life experiences in the engineering college. The interview will take one to one and a half hour and it will be audio-taped. In addition, you will be observed during a regular day at your institution. There will be no monetary compensation for participating in this study.

This study is confidential. I will use an alias to identify the participants. No identifiers linking you to the study will be included in any sort of report that might be published. Your contributions will be quoted with an alias. The records of this study will be kept securely and only my chair, Dr. Sandlin, and I will have access to the records. I will keep the tapes securely locked, and I will destroy them after 5 years of the publication of the study. Your decision whether or not to participate will not affect your current or future relation to Texas A&M or your institution. If you decide to participate, you are free to refuse to answer any of the questions that make you uncomfortable. You can withdraw at any time without your relations with the University being affected. You can contact me Carmen G. Villa at cgvilla@neo.tamu.edu (979) 845-1561, and Dr. Jenny Sandlin at jennifer.sandlin@asu.edu (979) 458-0508 with any questions about this study.

This research study has been reviewed by the Institutional Review Board- Human Subjects in Research, Texas A&M University. For research-related problems or questions regarding subjects' rights, you can contact the Institutional Review Board through Ms. Melissa McIlhaney, IRB Program Coordinator, Office of Research Compliance, (979) 458-4067, mcilhaney@tamu.edu.

Please be sure you have read the above information, asked questions and received answers to your satisfaction. You will be given a copy of the information sheet for your records.

PAGINA DE INFORMACION

El impacto de las experiencias de la vida estudiantil en la retención descrito por alumnas en escuelas y facultades de ingeniería en México. (Título tentativo)

Usted ha sido seleccionada para participar en un estudio de investigación sobre las mujeres en programas de ingeniería en México. Usted fue seleccionada por estar cursando al menos el penúltimo año de su carrera. Se seleccionaron en total entre 15 y 20 estudiantes para participar en este estudio cuyo propósito es identificar porque las mujeres permanecen en los programas de ingeniería en México.

Si usted acepta participar en este estudio, se le hará una entrevista donde compartirá sus experiencias como alumna de ingeniería. La entrevista tendrá una duración de entre una hora y una hora y media y será grabada. Además usted será observada durante un día regular de clase. No habrá compensación monetaria por participar en este proyecto.

Este estudio es confidencial. Ninguna publicación la asociará a usted con el estudio. Sus contribuciones serán citadas bajo un alias. Los registros (cintas grabadas) serán almacenadas de forma segura y únicamente mi directora de tesis y yo tendremos acceso a los registros. Las cintas serán guardadas bajo llave y serán destruidas después de 5 años de haber publicado la tesis. Su decisión de participar o no en el estudio no afectará de ninguna manera su relación con la universidad de Texas A&M ni con su institución. Si usted decide participar, usted es libre de no contestar cualquier pregunta que le haga sentir incomoda. Usted podrá retirarse de la entrevista en cualquier momento sin que esto afecte de alguna manera su relación con la Universidad. Usted podrá contactar a la Dra. Jennifer Sandlin o a mi si desea mas información sobre este estudio. (cgvilla@neo.tamu.edu (979)845- 1561, Dr. Jenny Sandlin at jennifer.sandlin@asu.edu (979) 458-0508.

Esta investigación ha sido revisada por el Comité Institucional de Revisiones-Investigación con Humanos en la Universidad de Texas A&M. (Institutional Review Board- Human Subjects in Research, Texas A&M University). Para preguntas o problemas referentes a los derechos de los participantes, favor de contactar al Comité Institucional de Revisiones - Investigación con Humanos, a través de Ms. Melissa McIlhaney, IRB Program Coordinator, Office of Research Compliance, (979) 458-4067, mcilhaney@tamu.edu.

Por favor asegúrese de leer la información, preguntar dudas y recibir respuestas satisfactorias. Se le entregara una copia de esta página para sus registros personales.

VITA

Maria Del Carmen Garcia Villa
4226 TAMU College Station, TX 77843-4226

EDUCATION

PhD Educational Administration and Human Resource Development 2008
Texas A&M University
Dissertation on underrepresented populations in higher education
College Teaching Certificate. 2006
Texas A&M University
Education Certificate. 1998
Universidad Panamericana, Mexico
Diplôme de Etudes Approfondies en Informatique 1984
Institute National Polytechnique, Grenoble, France
Bachelors Degree in Computer Science Engineering (Honors Degree) 1982
Tecnologico de Monterrey, México

PROFESSIONAL EXPERIENCE

Assistant Lecturer. Hispanic Studies Department, TAMU Fall-2008
Program Assistant. Hispanic Studies Department, TAMU 2007-2008

Graduate/Research Assistant: College of Education, TAMU 2004 present
Student editor for QSE journal, TAMU 2004 present

Spanish Instructor: Mays Business School, TAMU 2006-2008

Culture and Protocol Instructor, Office for Latin American Programs, TAMU 2006
Program Coordinator. Office for Latin American Programs, TAMU 2004

Assistant Director School of Engineering. 1994-2001
Universidad Panamericana, Mexico
Academic and management activities for the School of Engineering. Management activities include Head Department, Assistant Director, and Associate Director. Academic activities included lecturing undergraduate and graduate level courses.

Independent Consultant, San Jose California. 1989-1993
Research and English - Spanish technical documents translations